AVING

QUESTIONS

FOR

Class and Home Work

BY

W. P. CRANKSHAW.

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Weaving Questions

FOR

CLASS AND HOME WORK.

Chiefly selected from the Examination Papers of the City and Guilds of London Institute

BY

W. P. CRANKSHAW,

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PREFACE

The object of this book is to provide a series of questions on

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The questions are intended to cover the subjects contained in the syllabuses for the first and second grade examinations of the above-named Institute, but no attempt has been made either to follow the order of those syllabuses or to subdivide the questions into agreement therewith, as there does not appear to be any real line of demarcation between the two grades, and it became possible in this way to avoid repetition and overlapping. It is therefore left to the discretion of the teacher to select the examples best suited to his immediate requirements and those of his students.

It is thought that the leaving of blank pages for notes will add considerably to the value of the book.

W. P. Crankshaw.

Salford, September, 1912.

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PREFACE

The object of this book is to provide a series of questions on the principles underlying the manufacture of woven fabrics and their practical application, which shall facilitate the class work of the teacher and help the student in his private studies.

The questions have been chiefly selected from the examination papers of the City and Guilds of London Institute with special reference to Cotton Weaving. But advantage has also been taken of the material afforded by the papers relating to other branches of the industry with a view to introducing variety into the work, a feature which, together with the fundamental nature of the majority of the questions, should make the book generally useful to those interested in the technology of weaving.

The questions are intended to cover the subjects contained in the syllabuses for the first and second grade examinations of the above-named Institute, but no attempt has been made either to follow the order of those syllabuses or to subdivide the questions into agreement therewith, as there does not appear to be any real line of demarcation between the two grades, and it became possible in this way to avoid repetition and overlapping. It is therefore left to the discretion of the teacher to select the examples best suited to his immediate requirements and those of his students.

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YARN NUMBERING OR COUNTING.

CLASS I.—DIRECT SYSTEMS

In which the "Count" or "Number" indicates the number of length units contained in one weight unit.

Description.	Length Unit.		Weight Unit.	Yds. per lb. in 1's Count
Cotton—				
English	Hank,	840 yards	1 lb.	840
French	,,	1,000 metres	½ kilo	992
Worsted	,,	560 yards	1 lb.	560
Woollen—				
Yorkshire skein	Skein,	1,536 ,,	6 lbs.	256
Dewsbury		1 yard	1 oz.	16
West of England	Snap,	320 yards	1 lb.	320
Galashiels	Cut,	300 ,,	24 oz.	200
Hawick	,,	300 ,,	26 oz.	184·6
Alloa and Stirling	Spyndle,	11,520 ,,	24 lb.	480
American. Cut	Cut,	300 ,,	1 lb.	300
American. Run	Run,	100 ,,	1 oz.	1,600
Continental		1,000 metres	1 kilo	496
Linen—				
Fine or wet spun	Lea,	300 yards	1 lb.	300
Silk—				
Thrown. Ounce system	Hank,	1,000 ,,	1 oz.	16,000
Spun	,,	840 ,,	1 lb.	840
Metric—				
All yarns	,,	1,000 metres	1 kilo	496
Decimal—				
All yarns	,,	1,000 yards	1 lb.	1,000

CLASS II.—INVERSE SYSTEMS

In which the count indicates the weight of one length unit.

Description.	Length Unit.		Weight Unit.	Yds. per lb. in 1's Count
Woollen—				
Halifax and Sowerby Bridge		80 yards	1 dram	20,480
American. Grain		20 ,,	1 grain	140,000
Aberdeen	Spyndle,	14,400 ,,	1 lb.	14,400
Jute—				
Also coarse and dry spun linens	,,	14,400 ,,	1 lb.	14,400
Silk—				
Thrown. Denier system		520 ,,	1 denier	4,437,333
Thrown. Dram system		1,000 ,,	1 dram	256,000

PART I.

CALCULATIONS.

1.—YARNS AND YARN NUMBERING.

1. State the features and uses of the following classes of cotton yarns:—Twist, weft, doubled, waste, condenser, carded, combed, ring, mule, gassed.

2. Explain the following terms applied to cotton yarns:—Cop, twist cop, pin cop, hank, cross reel, lea or wrap reel, single hank, double hank, bundle, warping bobbin, cheese, cone, warp, ball warp, chain warp, back beam, loom beam, lease, end-and-end lease, half beer lease.

3. Name the various forms in which cotton yarns may be purchased from the spinner. Account for the particular form in which the spinner may deliver the yarn or why the manufacturer may so desire it.

4. What factors determine the order and nature of the processes through which cotton yarn is passed in preparation for weaving? Outline the usual processes (*a*) for grey goods, (*b*) for coloured goods.

5. Explain the general principles of counting or numbering yarns. Give the basis of the systems used for numbering cotton worsted, linen, and woollen.

6. Define the term "count" or "number" as applied to cotton yarn. Give the basis of counting cottons below 1's counts; jute; raw silk; and spun silk.

7. Give the length of yarn in the following:—

(*a*) A 10 lb. bundle of 40's cotton.
(*b*) 4 cops of 24's cotton weighing 3½ ozs.
(*c*) A warp of 20's cotton 2,400 ends 90 lb.
(*d*) 6½ lb. of 36's worsted.
(*e*) One gross hanks of 16's worsted.
(*f*) 5 lb. 30 skeins (Yorkshire) woollen.
(*g*) 25 lb. 16 lea linen.
(*h*) 25 bundles 60's linen.
(*i*) 25 lb. 12 lb. jute.
(*j*) 4 spyndles 8 lb. jute.
(*k*) 4½ lb. 40/2 spun silk.
(*l*) 8 lb. 5,000 (oz. count) organzine silk.
(*m*) 14 ozs. 60 denier silk.
(*n*) 3¼ lb. 30/32 denier silk.

8. How many yards of yarn are there in 12 lb. of bleached cotton which wrapped 14's in the grey state and lost 8 per cent. of weight in bleaching?

9. How many spyndles are there in 425 lb. of 2 lb. dry spun linen which has been reduced 15 per cent. in weight by bleaching?

10. How many bundles of 40's linen are equal in length to (*a*) 20 gross hanks of 40's worsted and (*b*) 20 lb. of 40's cotton? (*c*) How many lb. of 50's linen are equal in length to 30 lb. of 20's cotton? (*d*) What cotton count is equal in weight to 40's linen?

11. Calculate the weight of :—

(*a*) 35,000 yards of 40's cotton.
(*b*) 50,400 ,, 60/2 spun silk.
(*c*) 100 bundles of 50 lea linen.
(*d*) 16 hanks of 28's cotton.
(*e*) A warp of 1,650 ends 630 yards 14's cotton.
(*f*) In drams and grains of 160 yards 20's worsted.
(*g*) 3,360 yards of 15 skeins (Yorkshire) woollen.
(*h*) 17,000 yards 80 denier silk.
(*i*) 24's cotton to enable 10 hanks to be wound upon each of 360 warping bobbins.

12. What is the price per lb. when 25 lea linen is quoted 8/- per bundle, and 40 lea 6/- per bundle?

13. In $5\frac{1}{2}$'s cotton counts how many yards are there per lb., and how many hanks per lb. in 100's "bump" counts?

14. Give the cotton counts of the following yarns :—

(*a*) 226,800 yards, 15 lb. in weight.
(*b*) 40,320 ,, , 3 lb. ,,
(*c*) 2 hanks, weighing 9 dwt. $2\frac{3}{4}$ grains.
(*d*) 15 double hanks, weighing $\frac{3}{4}$ lb.
(*e*) 22 cops each containing 960 yards and 1 lb. in weight.
(*f*) A 10 lb. bundle containing 210 hanks each measuring 760 yards.
(*g*) A warp of 1,920 ends, 630 yards, 72 lb. weight.
(*h*) $10\frac{1}{2}$ yards of warp 2,400 ends $7\frac{1}{2}$ ozs. weight.
(*i*) When 42 cops, each containing 480 yards, weigh 1 lb.

15. Give (*a*) the worsted count when 60,480 yards weight $4\frac{1}{2}$ lb.
(*b*) ,, woollen skeins of 222,720 yards, 80 lb. weight.
(*c*) ,, linen count of 6 bundles weighing 17 lb. after losing 15 per cent. of weight in bleaching.

16. Give the tables of weights and measures used in numbering cotton and worsted yarns. Explain how you would proceed to test the counts of cotton yarn supplied in the cop, hank, and ball warp, and on the back beam. What is the effect of conditioning, bleaching, and sizing upon the counts?

17. (*a*) A lot of cotton yarn wraps 20's but it contains 5 per cent. excess moisture. What is the count in the correct condition? (*b*) Find the original or grey count of cotton yarn which lost 8 per cent. in bleaching and then wrapped 24's. (*c*) A warp had 25 per cent. of size added and then wrapped 36's. Find the unsized count. (*d*) 4 leas of cotton yarn weigh 200 grains and contain 5 per cent. of added moisture; give the counts in the damp condition, and also as originally spun. (*e*) Give the correct count of yarn on a back beam 420 ends 16,800 yards 210 lb. containing 5 per cent. of excess moisture.

18. State and prove the rules for finding the count of cotton yarns. Give the counts of the following :—

(*a*) $12\frac{1}{4}$, 26, 32, and 40 grains per cotton lea.
(*b*) 2 leas 3-fold cotton, 5 dwts. 5 grains.
(*c*) 3 leas worsted, 2 dwts. 5 grains.
(*d*) 120 yards linen, 4 dwts. 16 grains.
(*e*) 72 yards cotton, 20 grains.
(*f*) 43 inches 2-fold cotton, $5\frac{1}{2}$ grains.
(*g*) 120 yards worsted, 50 grains.
(*h*) 120 ,, spun silk, 40 grains.

19. Give the average wrapping when single leas weigh as follows :—

(*a*) 25, $25\frac{1}{2}$, 26, $26\frac{1}{2}$ grains.
(*b*) 30, 31, 29, $29\frac{1}{2}$, 30, $32\frac{1}{2}$ grains.
(*c*) 4 dwts. 4 grains; 4 dwts. 12 grains; 3 dwts. 22 grains; 4 dwts. 1 grain.

20. Give the count when (*a*) 20 threads of a single yarn weigh the same as 16 threads of 2/40 cotton; (*b*) when 10 threads of worsted weigh the same as 15 threads of 32 skeins woollen. Equal lengths in each case.

21. Find the weight of 1 lea of each of the following :—12's, 25's, 32's, 40's cotton. Also of 50 yards 6's; and 15 yards 3/24's.

22. Convert to cotton counts :—60's worsted, 50's linen, 8 lb. jute, 4 dram silk, 40's metric, 35 denier silk, and give the number of yards in 10 lb. of each.

23. Give the equivalent worsted count of 30 skeins woollen, 42's Gala. (Galashiels), 60/2 spun silk, 18,000 organzine silk; 2/36 cotton.

24. Convert to Yorkshire skeins woollen count :—15's Hawick, 20's West of England, 30 cut Gala., 8's Sowerby Bridge, and give the number of yards in 12 lb. of each yarn.

25. Reduce to dram silk counts, 50/54 deniers, 60/2 spun, 8,000 yards tram.

26. Give the count in the decimal system of 36's cotton, 40's worsted, 60/2 spun silk, 16 skeins woollen, 35 linen, 12 lb. jute, 40 denier silk.

27. Change (*a*) 40's linen to metric and cotton counts; (*b*) 30 deniers to spun silk count; (*c*) 40's cotton English to French counts; (*d*) 40's cotton French to English and decimal counts; (*e*) 30's linen to jute counts; (*f*) 16 lb. jute to linen counts.

II.—DOUBLED YARNS.

1. Find the R.C. (resultant count) of doubled yarns composed of one thread of each of the counts stated. Neglect contraction :—

(*a*) 60's and 40's.
(*b*) 60, 30, 20.
(*c*) 50, 40, 20.
(*d*) 56, 28, 14.
(*e*) 40, 20, 10.
(*f*) 60, 40, 30, 10.
(*g*) 80, 60, 40, 30.
(*h*) 70, 50, 40, 20.
(*i*) 48, 32, 24, 16.

2. Calculate the percentage composition of the yarns *a*, *b*, *d*, and *f* in question 1.

3. Find the weight of each count required to produce 240 lb. of each of the yarns *c*, *e*, *g*, and *h* in question 1.

4. Find the price per lb. of yarn (*b*) question 1, when 60's costs 1/8, 30's 1/4, 20's 1/-, and doubling 1d. per lb. of the doubled yarn.

5. Give the cost of yarn (*f*) question 1, when the prices are 2/2, 1/8, 1/4, 1/2 per lb. respectively and doubling 2d. per lb.

6. Name some of the objects of doubling cotton yarns, and state for what purposes such are used.

7. Give the cotton R.C. of twisting (*a*) 30 cotton. 30 worsted; (*b*) 30 cotton, 30/2 spun silk; (*c*) 2/60 cotton, 2/60 worsted, 60/2 spun silk. Also the worsted R.C. of 24's cotton and 24's worsted.

8. Find the R.C. in worsted (*a*) of twisting together 60's worsted and 35 skeins wool; (*b*) 40's worsted and 56 cut Gala.; (*c*) 2/64 worsted and 64/2 spun silk; (*d*) 2/40 cotton and 32 mohair; (*e*) 20 worsted, 16 cut Gala., 2/18 cotton.

9. Find R.C. also cost and weight of each yarn for the quantities stated :—

(*a*) In Cotton cts. 2 threads of 40's worsted at 2/2, 1 thd. 60 cott. 1/8; doubling 2d. per lb. 100 lb. of yarn.
(*b*) In Worsted cts. 2/84 wors. 4/-, 2/60 wors. 3/-, 50/2 sp. silk 15/-; doubling 3d. per lb. 100 lb. of yarn.
(*c*) In Cotton cts. 60/2 silk 20/-, 2/40 cott. 1/6, 20 sks. wool 2/-; doubling 3d. per lb. 162 lb. of yarn.
(*d*) In Woollen cts. 40 sks. wool 2/8, 60/2 silk 15/-, 2/48 wors. 3/-; doubling 3d. per lb. 100 lb. of yarn.
(*e*) In Worsted cts. 40 wors. 2/6, 30/2 silk 12/-, 30 wors. 2/-; doubling 3d. per lb. 180 lb. of yarn.

10. Give the equivalent woollen (Yorkshire) count when 2/48 worsted, 30 skeins wool, and 40/2 silk are twisted together.

11. Explain the influence upon yarn counts of the contraction which takes place in the operation of doubling. What is the R.C. (*a*) when 2 threads of 40's cotton are doubled together and contract 5 per cent. in the process? (*b*) When 60's cotton and 40's worsted are twisted together, the cotton contracting 10 per cent.?

12. A cotton gimp yarn is made by twisting together 2 threads of 2/40's and 1 of 8's single; 19 inches of the gimp contains 20 inches of the 2/40's and 40 inches of the 8's. Find the R.C.

13. A worsted loop yarn is composed of 2/20's taking up 2 ins. per yard, 5's taking up 30 ins., and 15's taking up 2 ins. per yard. Find the R.C. and percentage composition.

14. Find the cotton R.C., price per lb., and weight of each yarn in 240 lb. of the twist in the following knop yarn, using 24 in. 2/24 mohair at 3/-, 16 ins. 2/30 cotton at 1/6, 16 in. 2/48 cotton at 1/8, to 12 ins. of the twist, making to cost 2d. per lb.

15. Find the worsted R.C. of a spiral yarn composed of 2/56's worsted and 16's worsted, using 14 ins. of the former and 10 ins. of the latter to 9 ins. of the twist.

16. A loop yarn is made as follows:—

1 thread ground 40's cotton at 1/5 per lb., taking up 2 per cent. in twisting.
1 thread loop 16's mohair at 3/6 per lb., taking up 60 per cent.
1 thread binder 40's cotton at 1/5 per lb., taking up 5 per cent.
What is the R.C. and price per lb., allowing 2½d. per lb. for making?

17. Find the resultant counts and cost per lb. of a curl yarn made with 2 threads of 20-skein woollen at 1/8 per lb., 1 thread of 1/10's mohair at 2/2 per lb., and 1 thread 2/36's cotton at 1/2 per lb., (*a*) with the woollen taking up 5 per cent., the mohair 60 per cent., and the cotton 8 per cent.; (*b*) with the relative lengths as follows:— 38 inches of the woollen, 56 inches of mohair, 40 inches of cotton, to produce one yard of the twist. Allow 4d. per lb. for twisting.

18. Find the count marked x to produce the stated R.C. in conjunction with the given counts. Also weight of each thread:—

(*a*)	R.C. = 24's	using	60's and x	60 lb.
(*b*)	= 5's	,,	30's, 15's, and x	180 lb.
(*c*)	= 8 worsted	,,	30 wors., 60 wors., x wors. ..	100 lb.
(*d*)	= 15 sk. wool	,,	2/32 wors., x wors.	%
(*e*)	= 2/36 worsted	,,	60 wors., x spun silk	240 lb.
(*f*)	= 2/16 ,,	,,	2/60 wors., 30/2 silk, x wool ..	80 lb.
(*g*)	= 20 cotton	,,	40 cott., x wors.	96 lb.
(*h*)	= 12 worsted	,,	5 ins. 60 wors. to 3 ins. x worsted.	
(*i*)	= 10's ,, at 2/-	,,	12 ins. 2/60 wors. 3/-, 12 ins. 2/40 cott. 1/-, 15 ins. x mohair.	
(*j*)	= 10 sks. wool	,,	10 ins. 2/32 wors., 10 ins. 30 sk. wool, 15 ins. x silk.	

19. 250 lb. of 36's cotton are left over from an order, and it is decided to use it up in place of 2/24's by doubling with another count. What count and weight must be used?

20. What single count must be used to produce a two-fold yarn of actual R.C. = 12 hanks per lb., allowing for a take up of 4 per cent.?

21. If you have in stock 18's, 20's, 25's, 28's, 36's, and 38's, what will be the best combination to give a yarn of 8's R.C.?

22. What combination of 9's, 28's, 36's, and 45's will give the nearest to 3/30's?

23. A lea of 3-fold yarn weighs 152½ grs. per lea. Two of the threads are 16's and 20's respectively. What count is the third thread?

24. Find count of woollen yarn to twist with 2/48's worsted to make a twist = 14 yards per dram, assuming that 48 ins. of worsted and 40 ins. of woollen give 36 ins. of twist.

25. A three-ply twist equal to 10 skeins (woollen) is wanted. If 2/32 worsted, 30 skeins woollen, and a spun silk thread taking up 50 per cent. more than the others are to be used, what must the counts of the silk be?

26. Give the size and cost of a single mohair yarn for doubling with a twist yarn composed of one thread 2/60 worsted at 3/- per lb., and one thread 40/2 spun silk at 10/- per lb., and which will give a three-fold yarn equal to 10's worsted count at 5/6 per lb., including an allowance of 2 per cent. for waste and 2¾d. per lb. for making. Allow 15 ins. of mohair to every 12 ins. of the twist.

27. Give the average counts of yarn in the following warps:—

(*a*) 2,000 ends, warped 60 ends 40's cotton, 40 ends 24's cotton.
(*b*) 2,200 ,, 1,600 of which are 40's, 400 30's, and 200 12's.
(*c*) 1,800 ,, two-thirds 50's, one-fourth 20's, one-twelfth 10's.
(*d*) A warp arranged 2 ends 2/48's, 1 end 2/28's.
(*e*) ,, ,, 4 ends 24's, 2 of 18's, 4 of 36's, 2 of 18's.
(*f*) ,, ,, 1 end 2/60 wors., 1 of 30/2 silk, 1 of 2/60 wors., 1 of 2/40 cott.
(*g*) ,, ,, 1 end 30 wors., 2 of 2/36 cott., 1 of 30 sks. wool.
(*h*) ,, ,, 2 ends 2/40 wors., 1 2/40 sks. wool, 2 of 2/40 wors., 1 of 30 sks. wool.

28. What is the average counts of weft used in a shed of 200 looms weaving as follows:—50 looms 20's, 20 looms 30's, 10 looms 10's, 40 looms 40's, 80 looms 60's; assume the looms to use equal lengths of weft?

III.—REEDS.

1. Describe the construction and uses of reeds for weaving purposes. What are the features of a well-made reed? Why are different widths and gauges of wire used, and why are black dents sometimes inserted?

2. Enumerate as many types of reeds and "wraithes" as you are acquainted with both for preparatory and weaving purposes. Point out any special merit or demerit in their construction, and state for what make of fabric each type you mention is used, also how it is used and why.

3. Explain the following systems of reed counting:—Stockport, Radcliffe, Bolton, Bradford, Dewsbury, Jute, Scotch, and Silk. Give the constant number or multiplier to find dents per inch in each system, and also the count in each system, of a reed with 30 dents per inch.

4. Give the number of dents per inch in 30 reed Radcliffe, 40 Stockport, 36 Bolton, 40 porter jute, 20°° Scotch, and 2,200 silk.

5. Convert 30 reed Bolton to Stockport counts; 36 Radcliffe to Bolton; 40 po. jute to Scotch; 18°° Scotch to silk.

6. Name and describe three distinct methods of counting reeds in use in the Lancashire cotton trade. If a 5-end satin warp drawn 4 ends in a dent in a reed with 33 dents per inch was required to be altered to an 8-end satin with 3 in a dent, what reed would you use to bring the warp to the same width? Also how would you drop the heads if you had to use 8 shafts with 18 eyes per inch in each?

7. What is meant by a 74-reed Stockport counts? A warp of 3,420 ends covers $40\frac{2}{3}$ inches in the reed, and is dented as follows, what reed must be used?

10 dents	2's	= 20 ends			=	20 ends.
20 ,,	1	= 20 ,,				
6 ,,	2	= 12 ,,				
1 ,,	0	= 0 ,,		60 times	=	3,360 ,,
6 ,,	2	= 12 ,,				
1 ,,	0	= 0 ,,				
6 ,,	2	= 12 ,,				
20 ,,	1	= 20 ,,			=	20 ,,
10 ,,	2	= 20 ,,			=	20 ,,
						3,420 ,,

8. Find the number of warp threads necessary to cover 39 ins. in a 68-reed Stockport; 80 ins. in 42 Bolton 3 in a dent; 31 ins. in 4/30 Radcliffe; 40 ins. in a 27^{50} Scotch 2 in a dent; 22 ins. 2,000 3-thread silk. Add 40 extra ends for selvages in each case.

9. What will be the width covered by a warp of 2,840 ends (including 40 ends for selvages) in each of the following reeds:—2/80 Stockport, 3/40 Bolton, 2/30 Radcliffe, 15^{00} Scotch 2's, 2,400 2-thread silk?

10. How many ends must a warp contain to fill 32 ins. of a 66-reed Stockport to weave (*a*) a 6-end mock leno dented as follows:—1 dent 5 ends, 1 dent empty, 1 dent 1 end, 1 dent empty. (*b*) A 6-end mock leno with 3 ends 1 dent, 1 dent empty?

IV.—HEALDS.

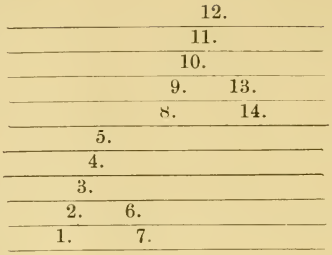
1. Describe the construction and uses of the various styles of healds you know. What are the essential features of a good set of healds, or what faults would cause a set to be considered unsatisfactory? State the points which determine (*a*) the thickness of the heald twine, (*b*) the depth of the healds, (*c*) the closeness and order of knitting, and (*d*) the number of shafts to a set.

2. What are the features of a good heald for weaving purposes? Give sketches showing the different styles you may be acquainted with, and state the particular class or weave of cloth each is best adapted for. What are spaced healds or healds knit to pattern, and when are they necessary? State the merits and defects of wire or slider healds as an alternative to spaced healds.

3. Name the basis of counting healds used in the cotton trade. What is a token and what is its purpose? How many tokens of 20 healds will you have on each stave in a 5-end satin with a total of 2,700 ends, and what space will each token stand on for a 90-reed Stockport?

4. Explain how you calculate the rate of knitting for healds. As examples, gives the rates of knitting for 8-end satin in 60-reed Stockport 4 in a dent; 8-end honey comb on 5 shafts 40-reed Bolton

2 in a dent, and the following draft to weave 2,100 ends 30 inches wide in the reed :—

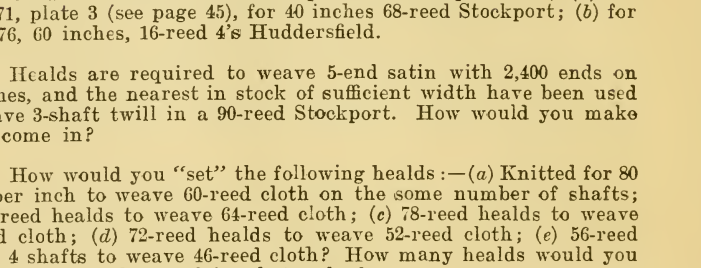


5. Find the number of healds per inch and per shaft, (*a*) for draft 71, plate 3 (see page 45), for 40 inches 68-reed Stockport; (*b*) for draft 76, 60 inches, 16-reed 4's Huddersfield.

6. Healds are required to weave 5-end satin with 2,400 ends on 30 inches, and the nearest in stock of sufficient width have been used to weave 3-shaft twill in a 90-reed Stockport. How would you make them come in?

7. How would you "set" the following healds :—(*a*) Knitted for 80 ends per inch to weave 60-reed cloth on the some number of shafts; (*b*) 80-reed healds to weave 64-reed cloth; (*c*) 78-reed healds to weave 64-reed cloth; (*d*) 72-reed healds to weave 52-reed cloth; (*e*) 56-reed healds 4 shafts to weave 46-reed cloth? How many healds would you cast out on 50 inches, and in what order?

8. If you had a warp containing 1,984 ends which had to be drawn in on 8 shafts of healds as draft given, width in reed 32 inches, what would be the total number of healds left empty if the front 4 shafts contained 18 healds per inch, and the back 4 shafts contained 4 healds per inch? Indicate by crosses on the draft in what position you would leave the empty healds on each shaft.



9. Give heald knitting instructions for :—

(*a*) Twill and satin stripe, 36 ins. wide in 60-reed Stockport, 5-end satin 4 in a dent, 3-end twill 2 in a dent. $1\frac{1}{2}$ ins. per pattern, $\frac{1}{3}$ satin and $\frac{2}{3}$ twill; half a twill stripe at each selvage.

(*b*) Twill and satin stripe, 32 inches in 70-reed Stockport. 6-end satin 4 in a dent, 3-shaft twill 3 in a dent. 2 ins. per pattern, 2/5ths satin, 3/5ths twill.

(*c*) Plain and satin stripe 34¼ ins. in 64-reed Stockport, plain stripe 60 ends 2 in a dent, satin stripe 156 ends 6 in a dent. A full plain stripe at each selvage.

(*d*) Mock leno stripe, 36 dents per inch in reed, with a plain stripe and an extra 12 plain ends at each selvage.

8 ends plain	2's		= 4 dents.
30 ends & 3 mock	1 dent 3 ends 1 ,, empty 1 ,, 3 ends	9 times	= 18 ,,
			= 1 ,,
8 ends plain	2's		= 4 ,,
16 ,, satin	4's		= 4 ,,
23 ends 5 & 1 mock	1 dent 5 ends 1 ,, empty 1 ,, 1 end 1 ,, empty 1 ,, 5 ends	3 times	= 12 ,,
			= 1 ,,
16 ends satin	4's		= 4 ,,
			48 ,,

10. What counts of healds would you use for each shaft of the following draft, and how would you drop them in order to avoid unnecessary friction, if required to be woven 72 ends per inch in the reed? Also, supposing it was considered advisable to order healds knit specially to pattern, in what form would you give out instructions for same—the warp to contain 2,322 ends (including selvage), and to stand 34¼ inches in width? (*25.*)

	12.						
	11.	13.					
	10.	14.					
	9.	15.		27.		33.	
	8.	16.		26.	28.	32.	34.
	7.	17.		25.	29.	31.	35.
2. 4. 6.		18.	20. 22. 24.		30.		36.
1. 3. 5.		19.	21. 23.				

11. Give the number of healds per stave and their order of distribution for the following draft to be woven in a reed with 36 dents per inch 2 in a dent, 34 inches of yarn.

					17.	
					16.	18.
					15.	19.
					14.	20.
					13.	21.
		4.	8.	12.		
	2.	6.	10.			
	3.	7.	11.			
1.	5.	9.				

12. Arrange healds to weave (*a*) draft 81, plate III., for 2/34 Radcliffe 32 inches wide. (*b*) Draft 86, plate III., for 2,160 ends, 30 inches in the healds.

V.—WARP CALCULATIONS.

1. Calculate weight of following warps :—

(*a*)	2,520 ends	500 yards	50 cotton.
(*b*)	60 beers × 40	405 ,,	36 linen ; also number of bundles.
(*c*)	4,000 ends	120 ,,	80/2 sp. silk.
(*d*)	7,200 ,,	90 ,,	40/44 denier raw silk.
(*e*)	5,760 ,,	150 ,,	2½ drams thrown silk.
(*f*)	1,400 ,,	360 ,,	3/50 worsted.
(*g*)	1,200 ,,	240 ,,	24 skeins woollen.
(*h*)	700 ,,	400 ,,	8 lb. jute.

2. What weight of twist would you order to make back beams to following particulars :—(*a*) 6 beams 420 ends 14,400 yards 32 cotton allowing for a wastage of 2½ per cent.; (*b*) 2,364 ends 18,000 60 cotton, waste allowance 1½ per cent.?

3. Calculate the number of cotton warps obtainable from the following :—

(*a*) 1,400 ends 540 yards from 1,200 bobbins each containing 11 ozs. 24. T., allowing 3 per cent. for wastage and yarn left on bobbins.

(*b*) 1,200 ends 720 yards from 2,000 bobbins each 14 ozs., 2/32, allowing 2 per cent. for waste, &c.

(*c*) 960 ends 560 yards from 900 bobbins each 12 ozs., 3/54, allowing 1½ per cent. for waste, &c.

4. Find the length of following warps :—

(*a*) 1,170 ends, 3/26 wors., from 81 lb. material, allowing 3% for wastage.

(*b*) 2,400 ends, 20 cott., from 300 bobbins, each 12 ozs. yarn, using 95% of material.

(*c*) 1 end, 2/20 cott. } 21 times
1 ,, 2/48 wors. }
1 ,, 2/20 cott.
1 ,, 3,500yds. silk
} Total ends = 4,800, using 20 lb. of cotton.

(*d*) 350 ends, 24 cotton, 281¼ lb. Suppose the beams were made 400 yards shorter and the weight kept the same, what would be the counts?

5. Find the counts of the following cotton warps :—

(*a*) 66 beers × 32 ends 560 yards, 50 lb.

(*b*) 3,200 ends 720 yards, 75 lb. after the addition of 25 per cent. size.

(*c*) 920 ends 800 yards invoiced as 24's but 6 lb. light.

(*d*) 1,610 ends 900 yards invoiced as 2/40 at 1/2 per lb. calculation weight; but the actual weight is only 82 lb.; give actual count and price per lb.

(*e*) 12 warps each 2,000 ends 700 yards 20. T. are sold by calculation weight at 10d. per lb., but are found to contain 6 per cent. excess moisture. Find the correct count and total overcharge.

6. Find number of ends 960 yards each from 200 bobbins 2/40's, each containing 14 hanks and using 96 per cent. of the contents.

7. Give number of ends and weight of each count in (*a*) a warp 480 yards 84 lb. warped 2 ends 2/48 worsted, 1 end 20 sks. woollen; (*b*) in a warp 300 yards 75 lb. warped—

1 end	2/20 cott.	}	4 times.
2 ,,	2/40 wors.		
1 ,,	2/20 cott.		
2 ,,	40/2 silk.		

8. State the number of back beams, ends per beam, length, also weight of twist on each, you would warp for an order of 200 pieces, 38 ins., 65 yards, 78 reed Stockport, 36's twist, assume the warp length to be 6 per cent. longer than the cloth length.

9. Give weight of each yarn required to make following warps, allowing 40 yards per hank for waste in each case:—(*a*) 960 yards 30 ins. in 100-reed Stockport; (*b*) 430 yards 31 ins. 68-reed Stockport.

(*a*)

30	ends	2/40 grandrelle.
3	,,	22 sky.
3	,,	20 indigo.
18	,,	2/40 grandrelle.
3	,,	24 pink.
3	,,	24 red.
60		

(*b*)

24 sky 18's.
2 blue 2/40.
4 white 2/40.
2 blue 2/40.
24 sky 18's.
6 white 2/40.
2 blue 2/40.
6 white 2/40.

70 × 30 patterns.
30

2,100
24 sky 18's.
32 2/40 white selvages.

2,156 Total ends.

10. A striped fabric has the warp arranged—

80 dents,	2 in a dent,	2/60 cotton	}	40 dents per in.
20 ,,	4 ,,	60/2 silk		30 ins. in reed.

The warp is 240 yards long. Find the weight of each material and give the average cotton count of the warp.

VI.—WEFT CALCULATIONS.

1. Calculate weight of weft in the following cloths :—

	Picks.	In Reed.	Length.	Material.
(*a*)	96 per in.	42 ins.	116 yds.	28 cotton.
(*b*)	18 per $\frac{1}{4}$ in.	48 ins.	120 yds. L.S., $36\frac{1}{2}$ in.	32 ,,
(*c*)	80 in.	$1\frac{1}{2}$ yds.	60 yds.	3/40 wors.
(*d*)	96 in.	84 ins.	120 ins.	30 linen.
(*e*)	120 in.	32 ins.	80 yds.	60/2 sp. silk.
(*f*)	30 in.	29 ins.	60 yds.	12 lb. jute.
(*g*)	80 in.	32 ins.	80 yds.	40 cott. / 40 wors. } twist.
(*h*)	100 in.	23 ins.	90 yds.	60/64 denier silk.

(*i*) 120 yards, 32 ins. in reed, 64 picks per inch, 16 weft, and also an extra spot of 12 picks, 2/40's every $\frac{3}{4}$ in.

2. What length of cloth can be woven from :—

(*a*) 100 lb. 18's cott., 40 ins. in reed, 56 picks per in., waste 5 %
(*b*) 30 lb. 2/48 wors., 32 ins. ,, 60 ,, ,, ,, 3 %.
(*c*) 15 lb. 24 cotton, 39 ins. ,, 18 picks $\frac{1}{4}$ in. waste 40 yds. hank
(*d*) 5 bundles 60 lea linen, 40 ins. in reed, 18 shots per Scotch glass.

3. Give weight of each kind of weft required to make 480 yards of cloth 36 inches wide in the reed, 64 picks per inch, checking pattern :—

24's black ..	20		2		2		20	
20's white ..		2				2		2
2/32's print ..				2				
24's helio. ..							4	4

} = 60 picks.

4. How many hanks of worsted would be consumed in weaving a piece 80 yards long, 64 picks per in., 68 ins. in reed?

5. Give the number of picks per inch (*a*) using 200 hanks of 20's cotton (waste neglected) 28 ins. in reed, 60 yards long; (*b*) using a total of 33 lb. material in the order 2 picks 20 wors., 1 pick 12's wors., 60 ins. in reed, 60 yards long.

6. Give cost of weft in a piece 96 yards long containing 1,960 ends including 40 for selvages; 36-reed Bolton 2 in a dent, 20 picks per $\frac{1}{4}$ in. 24 weft at $9\frac{1}{2}$d.; allowing 4 per cent. waste.

7. At 200 picks per minute and an efficiency of 85 per cent., how many yards of cloth $38\frac{1}{2}$ ins. wide on the table, 41 ins. in the reed, and 17 picks per $\frac{1}{4}$, would a loom produce in a 55-hours week, and what weight of 40's weft would it consume, including an allowance of 6 per cent. for waste?

8. Calculate weight of each colour of weft to make 760 yards cloth, 32 ins. in reed, 64 picks per inch, 18's weft, allowing $2\frac{1}{2}$ per cent. for waste.

Blue	4		4		
White.. ..	6	6	4	4	
Sky	2		4		
Red	2				

} 36 picks.

9. Calculate weight of each weft in 450 yards cloth, 31 ins. in reed, 80 picks per inch.

CHECKING PATTERN.

Twice { 20 sky 40's.
2 white 10's.
2 blue 10's.

20 sky 40's.
2 white 10's.
4 sky 40's.
2 white 10's.

76

10. If you had 200 lbs. 12's black weft, and wished to weave it up in a cotton trousering, 30 ins. wide in reed 50 picks per inch, how many yards would you make the warp (allow 40 yards per hank for waste)? Also if the trousering was checked 4 black 12's and 2 slate 16's, how many yards of warp would be required and what weight of 16's slate to use up the 200 lbs. of black?

11. Supposing you have to make a checked fabric 32 ins. wide in reed with 16 picks per ¼ in., checking pattern 14 picks of 20's cops and 4 picks 24's blue, and you desire to use up 30 lbs. of the 24's blue, what length would you make the warp, and what weight of cops would you require? Allow 40 yards per hank for waste, and 10 per cent. for shrinkage from warp to cloth length.

12. If you had 10 lbs. of 4's wadding weft and required to weave a fancy pique, 30 ins. wide in reed, 120 picks per inch, with the following weft pattern, what length of cloth could you produce and what amount of 40's cop and 2/80 indigo would be required to use up all the wadding weft? Allow 40 yards per hank for waste.

WEFT PATTERN.

16 cop 40's.
2 indigo 2/80's.
4 cop 40's.
2 wadding 4's.
4 cop 40's.
2 indigo 2/80's.

30

VII.—CLOTH CALCULATIONS.

1. Calculate the weight of following cloths:—

(*a*) 38 in. 38 yards; 16 × 14; 32T 34W; warp sized 40 per cent. Contraction 6 per cent.

(*b*) 30 in. 40 yards out of loom; reed 36 dents inch; 2 ends 40's and 1 end 24's in a dent; 108 picks 40's and 36 picks 10's per inch. Warps sized 15 per cent. Take-up of fine warp 20 per cent., of coarse warp 7½ per cent.

2. Find the percentage of size on the warps:—

(*a*) 44 in. 30 yds. 12 lb.; 14 × 14 per ¼ in.; 20T, 24W.

(*b*) 38 in. 38 yds. 8¼ lb.; 16 × 14 per ¼ in.; 32T/34W.

(*c*) 38 in. 38 yds. 8¼ lb.; 57-reed Stockport, 10 picks per ¼ in.; 34T/36W.

(*d*) 30 in. 60 yds. 12 lb.; 16 × 16, 4 down; 32T/34W.

(*e*) A piece of cloth 1 yard square weighing 1/5 lb. and counting 70 ends, 40'sT. and 70 picks 50W. per square inch.

3. Find yarn counts to make:—

(*a*) 34 ins. 60 yds. 14 lb. exclusive of size; 60 ends, 60 picks per inch.

(*b*) 38 in. 38 yds. 8¼ lb. including 90 per cent. size on warp; 13 × 12 per ¼ in.

(*c*) 38 in. 38 yds. 9 lb., one-third of which is size; 16 × 15; 2 down.

(*d*) 32 in. 36 yds. 7½ lb., one-third being size; 60 × 60 inch.

(*e*) A pattern 4 ins. square, 1 dwt. 20 grs., 70 ends 60 picks per inch.

4. What count of weft must be used to make (*a*) 38 ins., 38 yds., 8¼ lb.; 50-reed Stockport; 34T.; 10 picks per ¼ inch; warp sized 120 per cent. (*b*) 32 in. 100 yds., L.S. 36½ ins., 21¾ lb., 64 ends per inch, 26T., with 7 per cent. size retained, 64 picks per inch?

Calculate quantities for the following cloths:—

5. Fifty pieces each 90 yards, 60-reed 2 in a dent, 2,070 ends including selvages, 16 picks per ¼ inch, 20's cops. Warp take-up 8 per cent. Waste 40 yards per hank.

WARP PATTERN.

10 white 20's.
2 red 24's.
4 white 20's.
2 red 24's.
10 white 20's.
2 blue 28's.

Selvages 30 ends 2/32.

6. 96 yards cloth from 100 yards warp, 36 ins. in reed, 80 ends per inch in reed, 11 picks per ¼ in., 12 weft. Waste 40 yds. per hank.

WARP PATTERN.

4 ends 40's blue.
8 ,, 32's white.

12

7. 25 pieces 120 yards each from 128 yards warp, 2,400 ends (including 32 ends 2/36 selvages), 24 twist; 40 ins. in reed; 15 picks per ¼ inch, 20 weft. Waste 40 yards per hank.

5	pieces	all blue.			
5	,,	warped,	8	white	8 blue.
5	,,	,,	12	,,	8 ,,
5	,,	,,	2	,,	6 ,,
5	,,	,,	3	,,	1 ,,

8. 700 yards cloth, 40 ins. in reed. Waste 4 per cent. warp, 5 per cent. weft.

Warp	2,880 ends	800 yards	32T.
	1,400 ,,	720 ,,	24T.

Weft	72 picks per in.	32W.
	18 ,, ,,	200 yds. per oz.

9. 800 yards cloth, 880 yards warp, 1,940 ends, 32 ins. in reed, 64 picks per inch, 20's white weft. Allow 4 per cent. for waste in twist and 4½ per cent. for waste in weft.

WARP PATTERN.

6 white
4 pink
1 white
2 red
1 white
4 pink
6 white
8 blue
} 20's twist.

32
59 repeats + 24.

1,888
24
28 2/40 selvage.

1,940 ends total.

10. 700 yards cloth. Warp all 20's twist, 770 yards, 2,048 ends, 32 ins. in the reed, 64 picks per inch of 18's weft. Allow 5 per cent. for waste in the warp and 2½ per cent. for waste in weft.

WARP PATTERN.

Blue ..	4		4					36
White ..	6	6			4		4	56 repeats.
Sky ..	2					4		
Red ..	2							2,016
								32 2/36 selvage.
								2,048

WEFT PATTERN.

Same as the warp.

11. 500 yds. cloth from 540 yds. warp, 27 dents per inch, 52 picks per inch. Waste 40 yds. per hank.

WARF PATTERN.

20 blue 18's.
1 grandrelle { 30's yellow. 12 red. 20 green.
6 white 18's.
1 grandrelle, as above.
20 blue 18's.
4 red 20's.

52 ends in 27 dents.
30 repeats.

1,560
30 18's white selvage, 2 in dent.

1,590

WEFT PATTERN.

20 blue 12's.
2 grandrelle 2/40
4 white 16's.
2 grandrelle 2/40
24 blue 12's.
4 red 20's.

56

12. 100 pieces flannelette each 120 yards long from 130 yards of warp, 34 ins. in reed, 26's warp, 12 picks per $\frac{1}{4}$ inch, 12's weft. Allow 40 yards per hank for waste in both warp and weft.

WARP PATTERN.

* { 6 white. 4 pink. 2 white. 4 pink. 6 white.
4 sky.
6 white.
2 blue.
2 white.
2 blue.
6 white.
4 sky.

48 × 50 + 22* = 2,422
2/40 selvage 24

2,446

13. 760 yards sateen skirting from 800 yards warp; 32 ins. in reed; 120 ends per in., 16 picks per $\frac{1}{4}$ in., 24's blue weft sized. Waste 40 yds. per hank in warp and weft.

WARP PATTERN.

24's blue....	80	10	20	20	10	80	20	10	10	10	340 ends × 11 repeats + 60 blue and 40 selvages 2/40 white = 3,840 ends.
24's red	5	5		5	5						
2/40 orange..			20								
2/40 white ..						10	5	5	5	5	

14. 276 yards of cloth from 315 yards warp of the following grandrelle sateen shirting, 34½ ins. wide in reed, 64 picks per inch, 16's weft.

WARP PATTERN.

30 threads grandrelle composed of { 1 end 50's blue. / 1 ,, 40's grey. }

4	,,	red	24's counts.
4	,,	sky	
14	,,	blue	
4	,,	sky	
4	,,	red	
60			
56 repeats + 30 grandrelle.			
360			
300			
30			
60 selvage 2/40 white.			
3,450			

15. 600 yards sateen suiting; 648 yards warp; 31 ins. in reed; 110 ends per inch in reed; 64 picks per inch 24's blue weft. Warp pattern 27 blue 22's, 3 white 24's. Selvages 10 ends 2/40's white at each side. Waste 40 yards per hank.

16. 800 yards cloth; 2,048 ends 880 yards 20's twist; 64 picks per inch, 18's weft, checked same as warp. Warp waste 2½ per cent., weft waste 5 per cent.

Warp	Blue....	4		4	4	56 repeats + 32 selvage 2/36's.
	White ..	6	6	4		
	Sky	2		4		
	Red	2				

17. Calculate the amount of material required for 2,000 yards of "pique," woven 2 ends in a dent of 32's twist for face, and 1 end in a dent of 24's stitching warp, 38 dents per inch and 27 ins. wide in reed. 110 picks per inch of 40's weft in face, with 10's wadding weft crammed in extra by stopping the take-up.

CHECKING PATTERN.

10	picks	40's cop weft.
2	,,	10's wadding.
12		

Shrinkage from reed to cloth width 1¼ ins. For shrinkage of face warp to cloth length allow 20 per cent.; for shrinkage of back warp to cloth length allow 5 per cent. Allow 40 yds. per hank waste in weft.

18. Calculate the amount of material in 100 pieces of repp fabric woven in a reed 36 dents per inch, three ends in a dent, 30 ins. wide in reed. The warp to have two threads 2/32's white mercerised yarn and one thread of 2/60's white in each dent. The warp length of 2/32's to be 80 yds. and the 2/60's to be 84 yds. per piece. Weft to be 2/80's white polished yarn, 60 picks per inch. Cloth length 72 yds. Allow ½ in. for shrinkage from reed width, and 40 yds. per hank waste in warp and weft.

19. What weight of each kind of material would be required for a Madras muslin curtain, 56 ins. wide, in a reed with 24 dents per inch, 2 ends of 40's warp in each dent, 400 yards cloth from 450 yards warp, 32 picks per inch of 50's weft for ground and 32 picks of 10's weft for figure?

VIII.—PREPARATION CALCULATIONS.

1. (*a*) What would be the cost of labour per 100 yards of warp in the preparatory processes for a warp of 3,000 ends 24's twist 800 yards long—winding 7d. per 10 lb. bundle; warping 8d. per 1,000 hanks; beaming 1½d. per 120 yards; drawing-in 6½d. per 1,000 ends?

(*b*) What would be the cost of winding the following:—

12	bundles (10 lb. each)	of	40's at	4½d.	per 100 hanks.
12	,,	,,	32's ,,	4d.	,,
12	,,	,,	2/24 ,,	3¾d.	,,

2. What would be the cost in wages for preparing the warp to make 100 pieces of cloth, each requiring 120 yards of yarn (neglecting any waste in winding) and 2,000 ends per piece of 20's twist?

Rate of payment: 24d. per 100 lbs. for winding.
1·5d. per 400 ends per 1,000 yards for warping.
7⅛d. per 2,000 ends per 1,000 yards for sizing.

3. If you had to weave 6,000 yards of cloth 36 ins. wide in the reed, with 80 picks per inch of 50's weft, what would be the difference in cost (1) if you bought the weft in the hank at 1/- per lb. and paid 7d. per bundle for bleaching, 1d. per 25 hanks for winding, and allowed 40 yards per hank for waste; and (2) if you bought 50's pin cops at 11d. per lb. and paid 1d. per lb. for cop bleaching, and allowed 70 yards per hank for waste?

4. If you required a warp containing 2,000 ends of 24's indigo blue, 800 yards long, which would be the least expensive way to produce it of the two following:—1st, by Yorkshire dressing at 4d. per cut of 70 yards for 1,200 ends, and an additional ½d. per cut for every 100 ends over 1,200; 2nd, by winding, warping, and beaming at 7d. per 10 lb. bundle for winding, 7d. per 1,000 hanks for warping, and 1d. per 90 yards for beaming? Name any other particulars, besides wages, which you think ought to be taken into consideration.

5. What would be the cost of beam warping and slashing for 500 pieces of cloth; 100 yards of warp per piece, 2,400 ends 24's counts, 480 ends on a beam. Rate of payment:—5d. per wrap of 3,500 yards for warping, and 6/- per 100 pieces of 100 yards for slashing?

6. What would be paid for the winding, warping, and drawing-in of a warp containing 2,400 ends, 720 yards long, 24's counts, if the rate of pay was 6½d. per bundle for winding, 7d. per 1,000 hanks for warping, and 5¾d. per 1,000 ends for drawing-in?

7. If the rates for winding and warping are 1d. per 36 hanks and 8d. per 1,000 hanks respectively, what would be the average wages of 18 winders and 4 warpers who turned off in one week the following quantities of yarn:—

1,000 lbs.	40's.
1,000 lbs.	20's.
1,500 lbs.	32's.
600 lbs.	24's.
400 lbs.	16's.

8. A beam warper earns 24/- per week for warping 32's twist, 450 ends on a beam, and is paid at the rate of 1¾d. per 1,000 yards. What length and weight is produced? Also what number of winding spindles would be required to supply the warper with bobbins, assuming each spindle to earn 5½d. per week at the rate of 0.36d. per lb.?

9. A winder tending 16 ends earns 15/- per week at the rate of 7½d. per bundle for 24's twist. How many ends would be required to supply three warpers who earn £1 per week at the rate of 7d. per 1,000 hanks?

10. Calculate wages for following work:—

Winding: 10 bundles each 18's, 22's, and 36's, at 1d. per 25 hanks.

Warping: 2 warps 2,200 ends, 576 yards; 4 warps 2,060 ends, 600 yards; 3 warps 1,880 ends, 700 yards, at 1d. per 100 hanks.

Yorkshire dressing: 2 warps 2,600 ends, 384 yards; 1 warp 2,100 ends, 840 yards; 1 warp 3,224 ends, 660 yards, at 5d. per 100 hanks.

Weaving: 132 yards, 60 picks per inch; 198 yards, 48 picks per inch; 176 yards, 56 picks per inch, at 4d. per pick per ¼ inch for 132 yards of warp.

IX.—WEAVING PRICES FROM THE UNIFORM LIST FOR GREY GOODS.

Find the weaving prices for the following cloths.
LS = 36½ ins. to yard.

	Style of Cloth.	Loom Width.	Cloth Width.	Length.	Reed.	Picks per ¼in.	Change Wheel.	Divi-dend.	Twist.	Weft.
1	Plain	36	32	116 L.S.	56	15			32	50
2	,, ...	41	36	50	68	21			36	40
3	,, ...	54	45	122 L.S.	80	20			44	54
4	,, ...	41	38	37½	58	13½			32	34
5	,, ...	36	29	24	1/36	11			14	16
6	,, ...	36	29	24	40	10½			16	18
7	,, ...	38	30	40	4/84	8			50	9
8	,, ...	45	38	60 L.S.	1/96	9			2/80	10
9	,, ...	40	32	24	90	24			80	80
10	,, ...	40	35	48	60	17			18	16
11	,, ...	38	31	76 L.S.	84	26			50	54
12	,, ...	44	38	38 L.S.	62		45	634	36	30
13	,, ...	50	45	75 L.S.	54		33	507	26	14
14	,, one split	66	56	60	56	16			36	30
15	4-shaft twill	45	37	50	1/44	12			30	9
16	4 ,, ,, ...	60	50	50	72	24			30	24
17	4-shaft herring bone.	66	58	63	66	19			34	26
18	8 ,, ,,	38	30	75 L.S.	78	23			28	30
19	12-shaft dobby	45	37	60	58	17			2/40	16
20	5-shaft sateen	37	31½	90 L.S.	68	26			36	38
21	5 ,, ,, ...	37	29	120	90	35			60	54
22	8 ,, ,, ...	40	31	69 L.S.	58		12	507	20	30
23	Jean	38	30	100	80	13			20	14
24	Florentine	38	30	80	4/40	14			14	18
25	5-shaft drill	40	29	116 L.S.	5/54	18			18	16
26	5 ,, ,, ...	40	30	90 L.S.	3/36	13			20	26
27	3-shaft jean	36	29	42	3/80		26	528	26	24
28	Brocade	38	31	60	80	24			40	44
29										
30										

X.—COST OF CLOTH.

1. Find cost per piece of plain grey cloth: 32 in./116 yds. 16 × 16, 32T/54W.

Actual ends 62 per inch, actual picks 62 per inch.
Total ends 2,000, warp length 122 yards.
Yarn width 34 ins. Waste allowance 5 per cent.
Weaving price 3/-. Expenses 75 per cent. of weaving. 32's 10d., 54's 1/- per lb.

2. Give cost of making 100 pieces to following particulars:—Width in reed 38⅜ ins.; 72 reed; 30's twist at 10½d.; cloth 75 yards L S. 36½ in.; warp 8 per cent. longer than cloth; 24 picks per ¼ inch 34's weft at 10¼d. Allow 40 yards per hank for waste in both warp and weft. Allow 1d. per lb. for preparing warp. Weaving price 2¼d. per pick per ¼ inch per 100 yards cloth; overlooking 7½ per cent. of weaving price; other expenses 70 per cent. of weaving price.

3. Give cost per yard of following stripe cloth:—Brocade stripe of 3 ins. 2 in a dent, sateen stripe of 2 ins. 4 in a dent, alternate; 40 ins. in the reed, 64-reed Stockport; 40'sT. at 14d. per lb. in the loom, 24 picks per ¼ in., 30'sW. at 10d. Weaving ¾d. per yard. Expenses 10 per cent. more than weaving.

4. What would be the cost per yard of the following regatta check cloth?

800 yards cloth from 850 yards warp.
24 dents per inch in reed. 60 picks per inch.

WARP PATTERN.			CHECKING
39 blue 24's	in	13 dents	32 cops 20's
3 white 2/40	,,	1 dent	2 blue 24's
6 blue 24	,,	2 dents	4 cops 20's
1 white 2/40 } 5 blue 24's }	,,	2 ,,	2 blue 24's 4 cops 20's
1 blue and white grandrelle 4/16	,,	1 dent	2 blue 24's 4 cops 20's
5 blue 24's } 1 white 2/40 }	,,	2 dents	2 blue 24's 4 cops 20's
6 blue 24's	,,	2 ,,	2 blue 24's
3 white 2/40	,,	1 dent	—
—		—	58
70		24	
32 repeats		32 repeats	
140		48	
210		72	
2,240		768	
36 blue selvage		12 dents selvage	
2,276		780	

PRICES.

Warp—24 blue warp-sized, 1/3 per lb.
2/40 white, warp-sized, 11d. per lb.
4/16 blue and white grandrelle, 1/- per lb.
Weft—20 cops, 9d.
24 blue cops (dyed), 1/1 per lb.
Dressing, 8½d. per 70 yards warp.
Drawing-in, 6½d. per 1,000 ends.
Weaving, 4d. per pick per ¼ in. for 100 yards cloth.
Expenses, equal to weaving.
Finishing, ¼d. per yard.

5. Calculate the cost per yard of the following coloured check cloth. Particulars are: 100 yds. of cloth requires 112 yds. of twist to produce it; picks per ¼ in. 16, reed 60's:—

Warp is composed of	1,200 ends	20's white (bleached)	at 12¼d.	per lb.
,, ,,	250 ,,	24's sky ..	at 13¼d.	,,
,, ,,	250 ,,	3/60's red ..	at 20d.	,,
,, ,,	420 ,,	2/50's indigo ..	at 19d.	,,
,, ,,	40 ,,	2/32's selvage ..	at 13½d.	,,

Dressing warp .. 5½d. per 100 hanks.
Drawing-in warp, 18d. per warp of 600 yards.
Weft checking is ½ of 16's bleached cop at 11d. per lb.
,, ⅛th of 20's sky .. at 11¾d. ,,
,, ¼th of 26's indigo .. at 14d. ,,
,, ⅛th of 18's red .. at 11⅛d. ,,
Winding weft .. 5½d. per 100 hanks.
Weaving ..... 3¾d. per pick per ¼in. per 100 yds.
Extra charges to be double weaving.

6. Find cost per yard of matting shirting cloth as follows:—500 yards cloth. Reed 36 dents per inch. 32½ ins. wide in reed, viz., 32 ins. 2 ends 24's and 1 end 40's in a dent, ½ in. selvages. 15 picks per ¼. 20's soft white weft.

WARP PATTERN.

No. 1 Beam, 520 yards.	*No. 2 Beam, 540 yards.*
4 blue 24's	1,152 ends 40's white
4 white 24's	36 ,, selvages 2/40 white
4 blue 24's	
24 white 24's	1,188

36 × 64 repeat = 2,304 ends.

Waste 40 yards per hank in both warp and weft.

PRICES.

24's warp ..	9½d.	per lb.
40's warp ..	1/1	,,
2/40's selvage	1/-	,,
20's weft	9d.	,,

Bleaching warp and weft, 8d. per bundle.
Dyeing blue, 3d. per lb.
Sizing, 7d. per bundle.
Winding warp, 1d. per 30 hanks.
,, weft, 1d. per 20 hanks.
Warping, 8d. per 1,000 hanks.
Beaming, 1d. per 100 yards.
Drawing, 7d. per 1,000 ends.
Weaving, 3d. per pick per $\frac{1}{4}$ in. for 100 yds. cloth.
Expenses, $1\frac{1}{4}$ times the weaving price.

7. Cost per yard of quilting cloth, 72-reed (Stockport), 31 ins. in reed:—

Face warp 2 in a dent 60's at 18d., 1·25 yards warp per yard of cloth.
Back ,, 1 ,, 32's at 14d., 1·1 ,, ,, ,, ,,

Total picks per inch 180 in the order of 10 picks 50's at 14d. to 2 picks 12's at 10d. Weaving $2\frac{1}{4}$d. and expenses $2\frac{1}{2}$d. per yard.

8. Cost per piece of 100 yards from 105 yards warp of check fabric. Other costs besides those mentioned to be covered by a sum equal to $1\frac{1}{4}$ times the weaving wage:—

WARP PATTERN.

	24 pink ..	30's	twist	at 1/2	per lb.
	6 white	40's	,,	at 1/3	,,
2	2 sky	2/40's	,,	at 11d.	,,
	2 white	40's	,,	at 1/3	,,
	4 pink ..	30's	,,	at 1/2	,,
	6 white	40's	,,	at 1/3	,,
	48				

To be checked same pattern as warp, but all 40's weft at 1/1 per lb. for colour and 11d. per lb. for white. 36 ins. wide in reed and 76 ends per inch in reed. Winding warp, 1d. per 25 hanks. Winding weft, 1d. per 18 hanks. Warping, 10d. per 1,000 hanks. Weaving, 3d. per pick per $\frac{1}{4}$ in. for 105 yards warp.

9. What would be the cost per yard of a figured repp cloth 32 ins. wide as follows:—Reed 40 dents per inch, 2 ends of 2/40's grey, and 1 end 2/80's in each dent; 33 ins. wide in reed, 18 picks per $\frac{1}{4}$ in. of 24 weft. Warp to be supplied on back beams. 2/40 warp, $10\frac{1}{2}$d. per lb.; 2/80's warp, at 1/6 per lb.; 24 weft cop, at 8d. per lb.; slashing, $\frac{3}{4}$d. per lb.; twisting, 4d. per 1,000 ends; weaving, 4d. per pick per $\frac{1}{4}$ in., for 80 yds. of cloth. Extra expenses $1\frac{1}{2}$ times weaving; dyeing and finishing, $1\frac{3}{4}$d. per yard; for 2/40's warp allow 12 per cent. for shrinkage; for 2/80's warp allow 5 per cent. for shrinkage; 24's weft allow 40 yds. waste per hank?

10. Cost per dozen tapestry table covers, 68 ins. wide in reed, 84 ins. long.

WARPS.

Binding warp	900 ends	2/60's black.
No. 1 ,, ...	5,400 ,,	2/40's fawn.
No. 2 ,, ...	5,400 ,,	2/40's gold.

WEFT.

60 picks per inch, 6's weft, slate and maroon, alternate picks of each. Cost of grey yarn 2/60's = 1/2 per lb., 2/40's 1/- per lb., 6's weft 6d. per lb. Dyeing and sizing, black 6d. per lb., fawn 4d. per lb., gold 4½d. per lb. Dyeing slate weft 3d. per lb., maroon 4d. per lb. Beaming warps 2d. per 100 yds. Winding weft ¼d. per lb. Weaving 5/- per dozen. Expenses, including gaiting, 1½ times weaving. Allow 40 yds. per hank waste of weft. 5 per cent. take-up of 2/40's warps and 10 per cent. take-up of binding warps.

11. What would be the cost per yard of the following terry towelling cloth:—200 yards cloth from 208 yards of ground warp and 728 yards of terry warp, 16 inches wide in reed, 50 picks per inch of 20 cops? The warp to be beamed, and the red and white terry threads run from bobbins when beaming. Allow 40 yards per hank for waste in weft and wound warp. Ground warp 476 ends 20's grey.

TERRY WARP.

8 grey	3/20's
6 red	3/24's
6 white	3/20's
6 red	3/24's
150 grey	3/20's
6 red	3/24's
6 white	3/20's
6 red	3/24's
8 grey	3/20's
202	

PRICES.

20's yarn in warp	9½d. per lb.
3/20 ,, ,, ...	11½d. ,,
3/24 ,, hank	11½d. ,,
3/20 ,, ,, ...	11¼d. ,,
20 cops	9d. ,,
Sizing warp	¾d. ,,
Dyeing and sizing red ..	4½d. ,,
Bleaching and sizing white	1d. ,,
Winding white and red ..	¼d. ,,
Beaming	1d. per 60 yards.

With 2d. per warp extra for running ends from bobbins.
Drawing 1/- per 1,000 ends.
Weaving 2/6 per 100 yards cloth.
Other expenses 3/- per 100 yards cloth.

12. What would be the cost per yard of the following cloth :—660 yards cloth from 700 yards warp, 36 dents per inch in reed, 72 picks per inch 24's soft blue weft? :—

WARP PATTERN.

40 blue	in	20 dents
2 print	,,	1 dent
4 blue	,,	2 dents
8 white	,,	2 ,,
4 blue	,,	2 ,,
2 print	,,	1 dent
60 ends	,,	28 dents
43 patterns + 40 blue		43 + 20
180		84
240		112
40		20
36		18
2,656 ends	in	1,242 dents

PRICES.

20 twist	at 9d.	per lb.
24 weft	at 9½d.	,,
Dyeing blue....	3½d.	,,
Printing	6d.	,,
Bleaching	7d.	per bundle
Sizing twist	6d.	,,
Winding warp ..	6d.	,,
,, weft ..	9d.	,,
Warping	1/2	per 1,000 hanks
Section beaming	1d.	,, 100 yards
Drawing-in	8½d.	,, 1,000 ends
Weaving.....	2/6	,, 70 yards of warp
Expense.....	3 9	,, 70 ,, ,,
Finishing	1/6	,, 66 ,, cloth

13. What would be the cost per yard of the following Oxford shirting cloth :—760 yards cloth from 800 yards warp, width in reed 33 ins., 30 dents per inch in reed, 40 picks per inch, with extra picks

crammed in as per checking pattern? Allow 40 yards per hank for waste in both warp and weft.

WARP PATTERN.			WEFT PATTERN.
48 white 40's	=	12 dents	32 white 12's
36 white 40's	=	12 ,,	2 sky 32's = 1
4 sky 40's	=	1 ,,	4 white 12's
12 white 40's	=	3 ,,	2 sky 32's = 1
4 sky 40's	=	1 ,,	16 white 12's
20 white 20's	=	10 ,,	2 sky 32's = 1
4 sky 40's	=	1 ,,	4 white 12'
12 white 40's	=	3 ,,	2 sky 32's = 1
4 sky 40's	=	1 ,,	—
144		44	64 = 60 picks in $1\frac{1}{2}$ ins.
22 repeats		22 repeats	
288		88	
288		88	
3,168		968	
66 selvage (20's white)		22 dents for selvage	
3,234		990	

PRICES.

40's white warp bleached and sized....	1/2	per lb.	
40's sky ,, dyed ,, ,, ...	1/4	,,	
20's white ,, bleached ,, ,, ...	11d.	,,	
12's white rove weft bleached	10d.	,,	
32's sky weft dyed	1/-	,,	
Winding 40's warp.....	1/2	per 10 lb. bundle	
,, 20's warp.....	$6\frac{1}{2}$d.	,,	,,
,, 12's weft	5d.	,,	,,
,, 32's weft	1/-	,,	,,
Warping	10d.	per 1,000 hanks	
Beaming warp	3d.		
Drawing-in	8d.	per 1,000 ends	
Weaving	3/2	for 100 yards cloth	
Other expenses	$1\frac{1}{4}$	times weaving	

14. Find average cost per yard of the following range of shirting fabrics all woven in a reed with 38 dents per inch; 31 ins. in

reed; 68 picks per inch, 10's bleached weft. All 2 in a dent, except 2/80's, which is 4 in a dent.

Pattern 1.		Pattern 2.		Pattern 3.	
24 blue ..	24's	44 blue ..	24's	24 white..	24's
4 white..	24's	4 white..	24's	4 sky....	24's
4 red	2/80's	4 sky....	24's	4 blue ..	2/80's
4 white..	24's	4 red	2/80's	4 sky....	24's
24 blue ..	24's	4 sky....	24's	24 white..	24's
4 white..	24's	4 white..	24's	4 blue ..	24's
64		64		64	

24's twist, 9d. per lb.; 2/80's, 1/8; 16 weft, 8d.; dyeing, blue 3½ per lb., sky 2d., red 5d.; bleaching, 7½d. per bundle; sizing, 7d. per bundle. Preparing warp, 1d. per 20 hanks; winding weft, 1d. per 20 hanks. Weaving and expenses, 4d. per pick per ¼ in. per 100 yards of warp.

15. Find the cost per yard of the following blouse material:—

400 yards cloth from 440 yards warp.
Reed, 34 dents per inch; 32 ins. wide in reed.
17 picks per ¼ in.; 32's blue and 2/40 white mercerised.
Checking pattern exact as warp pattern.

WARP PATTERN.

36	blue	40's
4	white mercerized	2/40's
36	blue	40
4	white mercerized	2/40
12	blue	40
10	white mercerized	2/40
12	blue	40
4	white mercerized	2/40
118		
18	repeats	
944		
1,180		
2,124		
24	blue *added*	
28	white 2/40 selvage	
2,176		

PRICES.

40 warp, 1/1 per lb.
2/40 selvage yarn, 1/0½ per lb.
32's weft, 10d. per lb.
2/40 white mercerized, 2/6½ per lb.

Bleaching selvage, ¾d. per lb.
Dyeing blue warp, 3½d. per lb.
Dyeing blue weft, 2½d. per lb.
Sizing blue warp and selvage yarn, 7d. per bundle
Winding 40's and selvage, 1d. for 30 hanks
Winding weft and mercerized warp, 1d. for 20 hanks
Warping, 8d. per 1,000 hanks
Beaming, 1d. per 100 yards
Drawing, 6d. per 1,000 ends
Weaving warp, 3d. per pick per ¼ in. for 100 yards cloth
Expenses same as weaving
Finishing, ¼d. per yard

Allow 40 yards per hank for waste in both warp and weft.

16. What would be the cost per yard of the following gauze dress goods fabric:—120 yards cloth from 128 yards ground and 180 yards lace warp; width in reed 33 ins., 20 dents per inch in reed, 72 picks per inch 36's bleached cop weft? Allow 40 yards per hank for waste in both warp and weft.

WARP PATTERN.

56	sky	32's	
4	white	32's	
1	sky	4/20	lace
8	white	32's	
1	sky	4/20	lace
4	white	32's	
74	threads =	18	dents
36	repeats	36	
444		108	
222		54	
2,664		648	
48	selvage	12	
2,712	ends =	660	dents space

Selvage 2/50's White.

PRICES.

32's yarn for warp	11½d. per lb.
4/20 ,, lace warp	1/1 ,,
2/50 ,, selvage	1s. ,,
36 weft (bleached)	10d. ,,
Bleaching warp	6d. per bundle
Dyeing sky..	3d. per lb.
Sizing warp	1d. ,,
Winding 32's	1d. ,,
Winding 4/20's	½d. ,,

Warping 1/- per 1,000 hanks
Beaming 1d. per 100 yards warp
Drawing-in 10d. per 1,000 ends
Weaving 5s. for 100 yards cloth
Other expenses $1\frac{3}{4}$ times weaving price

17. Oxford shirting. 660 yards cloth from 700 yards warp; reed 40 dents per inch, width in reed 34 ins.; 44 picks per inch, 10's sky weft.

WARP PATTERN.

16	sky	40's	in	8	dents
2	white	40	,,	1	,,
4	sky	40	,,	2	,,
2	white	40	,,	1	,,
16	sky	40	,,	8	,,
2	white	2/80	,,	1	,,
2	sky	40			
2	sky	40	,,	1	,,
2	sky	40	,,	1	,,
2	white	2/80			
50				23	
58 + 16 sky				58 + 8	
2,900				1,334	
16				8	
36 selvage 2/40 white				18	
2,962				1,360	

PRICES.

2/40 selvage	1/- per lb.
40's warp	1/5 ,,
2/80 ,, ...	1/9 ,,
10 weft Egyptian	11d. ,,
Dyeing warp and weft	3d. ,,
Bleaching warp	8d. per bundle
Sizing ,, ...	7d. ,,
Winding ,, ...	1/2 ,,
Winding weft	6d. ,,

Warping 9d. per 1,000 hanks
Beaming 3d. per 700 yards
Drawing 7d. per 1,000 ends
Weaving 2/- per 70 yards warp
Expenses 3/- per 70 yards warp
Finishing $\frac{1}{2}$d. per yard

Allow 40 yards per hank for waste in warp and weft.

XI.—CLOTH PROPORTIONING.

1. If the diameter of 60's yarn be $\frac{1}{212}$ins., find the diameter of 20's.

2. (*a*) What yarn has a dia. twice that of 60's; and (*b*) what yarn a dia. one-third that of 16's?

3. Give setting (*i.e.* reed and pick) for plain cloth, 2/1 twill, $\frac{3}{1}\frac{1}{3}\frac{1}{1}$ twill with a yarn $\frac{1}{120}$ins. diameter.

4.

	GIVEN.				FIND.
	Reed.	Pick.	Twist.	Weft.	
(*a*)	80	80	25	25	Yarns for 96 × 96
(*b*)	120	60	2/48	15	,, 100 × 50
(*c*)	20	20	60	64	,, 24 × 26
(*d*)	88	90	2/48	20	,, 2/36 × 16
(*e*)	18 porter		9 lb. jute		Setting for 12 lb. jute
(*f*)	44	44	22 skeins wool		,, 2/28 worsted

5. What yarns will give the same firmness in 2/2 twill that 20's gives in plain cloth?

6. Find reed for $\frac{2}{1}\frac{1}{2}\frac{1}{1}\frac{1}{1}$ twill to give same firmness as $\frac{2}{2}\frac{1}{2}\frac{1}{2}$ twill in 80 reed.

7. Having $\frac{1}{1}\frac{1}{3}$ twill in 60 × 60, 16T. 16W., what setting should $\frac{3}{5}$ twill have? Also what yarns should latter twill have if original setting be kept?

8. Having a plain cloth 80 × 64, 36T. 25W., give counts for a 2/2 twill 68 × 60.

9. Having 72 × 72, 2/60T. 32W., find setting for a cloth one-fifth heavier, also for a cloth one-fifth lighter.

10. Give setting for a 12 oz. cloth (*i.e.*, 12 oz. per yard) when a 16 oz. cloth is made 64 × 56, 2/40T., 34W. Prove your results.

11. A 20 oz. cloth is warped and wefted 2 threads 2/48 and 1 thread 2/28's. Give particulars for a 24 oz. cloth.

12. A 2/2 twill cloth is 60 × 60, 2/24T. and W. Give setting for a 3/3 twill to be one-fourth heavier.

13. Discuss the practical value of the rules usually given under the heading of "Cloth Structure" or "Cloth Proportioning," taking into account such points as modifications which it may be necessary or advisable to introduce on account of the style of yarns, structure, ultimate use and cost of the cloth; convenience in working; and reasons for the wide divergence from the theoretical structures of the majority of standard cotton fabrics.

PART II.

CLOTH STRUCTURE AND DESIGNING.

XII.—ELEMENTARY WEAVES.

1. Considering the whole range of textile fabrics, what classification would you make of them? Describe the characteristic features of each class you distinguish and illustrate the same as far as you can.

2. Upon what principle do you classify woven fabrics, and how many distinct varieties do you consider there to be? Briefly describe the same, and give sectional drawings of each class. What do you understand by the term "texture of cloth"?

3. Describe the various methods of representing interlacements or weaves on paper, and state the value of each method. Explain how the weave is repeated in the loom in both directions.

4. The fundamental or elementary weaves are: The plain, twills, and satins. Compare the value of each as regards power to give strength, weight, and ornamentation to the resulting fabric. In what manner does the plain surface given by the plain and the satin weaves differ, and what is the reason for the difference?

5. The two fundamental methods of ornamenting woven fabrics are (1) by weave and (2) by colour. Assess the value of each method as regards (*a*) effect produced, (*b*) facility of production, and (*c*) influence upon the wearing qualities of the fabric.

6. Define a "true plain cloth"; name its features and account for the same. Name and describe the various methods of ornamenting the plain weave, illustrating the same by sectional or other drawings and pointing out the peculiar or distinctive features obtained.

7. Describe the effects which would be produced by the following arrangements of warp and weft threads upon a plain weave fabric:—(*a*) Warp fine counts, weft very coarse. (*b*) Five threads fine and one thread coarse in both warp and weft, and (*c*) as (*a*) but every alternate thread heavily weighted and the other alternate threads very lightly weighted.

8. Give six point paper designs or sketches showing how a two-shaft weave can be ornamented by grouping of ends or picks, and by irregular or unequal counts of yarn. Suggest uses for the cloths produced in each case.

9. Sketch a few patterns for plain cord stripes and checks. In the latter case what method is commonly adopted for producing the equivalent of the cord weft, and what modifications are thereby imposed upon the selvages of the cloth, and the working of the take-up motion. Describe the mechanism for accomplishing these modifications.

10. Write out warping and wefting patterns for two stripe and two check designs to be formed by cord ends and picks in the plain weave. Why cannot true cord checks be woven in the ordinary plain loom, and what modification is made in the weave on this account?

11. Show by sectional drawings and point paper designs the construction of the following weaves:—Plain, warp cord, weft cord, matting, repp, poplin, and dice.

12. Arrange a stripe and also a check design, using plain, cord, and mat weaves. Do you think any difficulty would be likely to arise in weaving the stripe design as regards the tensioning of the warp threads? If so state the cause and explain how you would overcome the difficulty.

13. Suppose you change from a calico to a matting weave without altering the reed, pick, or yarns, how would the strength, firmness, width, and length of the cloth from the same length of warp be affected?

14. How should the warp and weft be proportioned to produce firm cloth in poplins, and also in cord weaves with warp and weft surfaces? Would you get the same length of each kind of cloth from 100 yards of warp? Give reasons for your answer.

15. What is the distinguishing feature of twill weaves? Show how this feature is obtained, and state the chief points to be observed in the proportioning or designing of a good twill weave in either warp or weft surface. What effect has the relative number of warp and weft threads per inch upon a twill weave?

16. Give point paper designs and sectional drawings of the following twills:—Jean, Harvard, sheeting, Florentine, Beatrice, $\frac{3}{1}\frac{3}{3}\frac{1}{3}$.

17. Mark out designs for:

(*a*) 8 distinct regular or plain twills upon various repeats (not less than 10×10), and draw a section of each.

(*b*) Give 8 examples of twills in common use and state what each is adapted for either by itself or in conjunction with other weaves, which must be named.

(*c*) All possible distinct twills on 7×7.

(*d*) Two examples each of wave, herring-bone, elongated, and corkscrew twills.

(*e*) Six elongated or stepped twills, using various moves.

18. State the features and uses of satin weaves, and explain how the former are secured by the arrangement of the warp and weft intersections. What is the difference between "perfect" and "imperfect" satins, and for what purposes are the latter used?

19. State the rules for finding the "intervals" in satin weaves, and construct a table of intervals for 4 to 16 ends. Also give one weave on each repeat.

20. What is the "satinette" weave? Give the point paper design for it. Also designs for six-shaft satins, and eight and twelve-shaft imperfect satins.

21. Give 3 satin and 3 twill weaves and explain the reason why the binding points are arranged differently. What difference is made in the proportioning of warp and weft threads and counts in twill and satin weaves? State the reason.

22. What do you understand by the terms "twist way" and "weft way" as applied to yarn? Why is the difference made? How does the direction of twist affect the fulness or precision of a twilled cloth?

23. Account for the influence of the yarn twist upon twill and satin weaves, and state the rules to be observed on account of this influence.

24. How does the degree of twist in warp and weft yarns affect the strength, elasticity, and appearance of the cloth? Also the contraction or take-up of the threads during weaving?

25. Give 5 and 8-end satin weaves, also the direction of twist in the warp and weft to produce "twill to right" and "twill to left" both "broken" and "bold" in each case.

26. Make a stripe design using the plain weave and 5-end satin; also another design using the plain weave and 6-end satin. What advantages has the latter combination over the former, and what order of denting is used to give the best effect in this class of patterns?

XIII.—FANCY WEAVES.

1. Give examples (one each) of zig-zag twills, viz.:—Regular (*a*) horizontal, (*b*) vertical, and irregular (*c*) diagonal, (*d*) diagonal reversed. What faults are liable to develop in cloth woven from these patterns, and what limitations are thereby imposed upon the base twill?

2. What are "broken" twills and how are they constructed? Give two examples.

3. What are the features and uses of corkscrew twills? Give examples upon 9 and 11 threads, also a fancy corkscrew. What is the correct proportioning of warp and weft, and the effect of coloured threads in the warp and weft?

4. Describe the features and construction of "elongated," "steep," or "reclining" twills, and state the points which require attention in designing the same? Give four examples.

5. How are "fancy twills" or "figured diagonals" produced? State the rules to be observed with reference to the style of twill and figure to be used and the repeat of the design. Illustrate the latter point by an example showing the necessity for the rule.

6. Design two fancy twills upon 16 ends and any number of picks, one to be a spotted diagonal comprising a twill at an angle of 45° and a spot repeating on 12 picks. In each case work out 32 picks, and say how many picks the designs will be complete upon.

7. Designs 49 to 53, plate I., show the commencement of various fancy twills. Complete the same. Also analyse the patterns, giving the separate repeat of each member, and show how you determine, by calculation or otherwise, when the patterns are completed.

8. Complete designs 23 and 24, plate I. Show how you determine when the patterns are completed, and endeavour to apply the rules used for questions 6 and 7.

9. The chief methods of weave origination are (1) rearrangement of threads; (2) building upon a predetermined basis; and (3) combination of weaves. Describe each method; give one design of each class, and suggest suitable fabrics for their application.

10. Describe and illustrate the method of pattern origination known as quadrantal rotation.

11. Construct weaves on 7, 9, 11, and 13-end sateen basis.

12. Construct new weaves (*a*) on 12×12 using a twill basis; (*b*) on 5×10, 10×10, and 10×20, using a sateen basis.

13. Give four rearrangements of $\frac{3}{2}\frac{1}{3}$ twill, each upon a different basis.

14. Using $\frac{3}{3}\frac{1}{2}\frac{1}{}$ twill, make six new designs by rearrangement n sateen, transposition, or other basis.

15. Construct weaves on 20 ends and 10 picks, and 30 ends and 10 picks, using a 10-end twill as basis.

16. State the object of combining twill or other weaves. Name the features which the base weaves should possess in order to give satisfactory results, and explain the method of determining the repeat.

17. Make designs by combining the following twills: (*a*) $\frac{2}{2}$, $\frac{3}{2}$; (*b*) $\frac{2}{2}$, $\frac{3}{2}$ moving 2; (*c*) $\frac{2}{2}$, $\frac{3}{1}\frac{1}{1}$; (*d*) $\frac{1}{3}\frac{1}{}$, $\frac{1}{2}\frac{2}{2}$, working out 24×24 and giving the number to repeat; (*e*) $\frac{3}{2}$ moving 2 and $\frac{3}{2}\frac{1}{1}\frac{1}{2}$ moving 1.

18. Show how different effects can be obtained by combining twills of the same repeat and starting one of the twills upon a different end or pick. As an example use two 8-end twills.

19. The ordinary method of combining twills doubles the repeat in one direction. Show how this can be avoided, and give two examples which repeat upon the same number of ends as picks.

20. Complete designs 25 and 34, plate I., and give the basis of construction adopted in each case.

21. What is a diamond weave, and how is it constructed? Why is it generally necessary to reverse upon a single end or pick? Give an examp'e to show how the rule may be departed from without objectionable results developing.

22. Give designs for 6-end bird eye, and 8 and 12-end diamond weaves, also an example to show how diamond patterns of large repeat can be produced by a small number of shafts.

23. Give designs for honeycomb weaves upon 6, 8, 12, and 16 ends and picks. State the cause of the cellular appearance of the cloth, and mark on the design the threads which form the centre of the cavity.

Plate I shows the commencement of a number of weaves which are to be completed, and have their basis of construction analysed and explained.

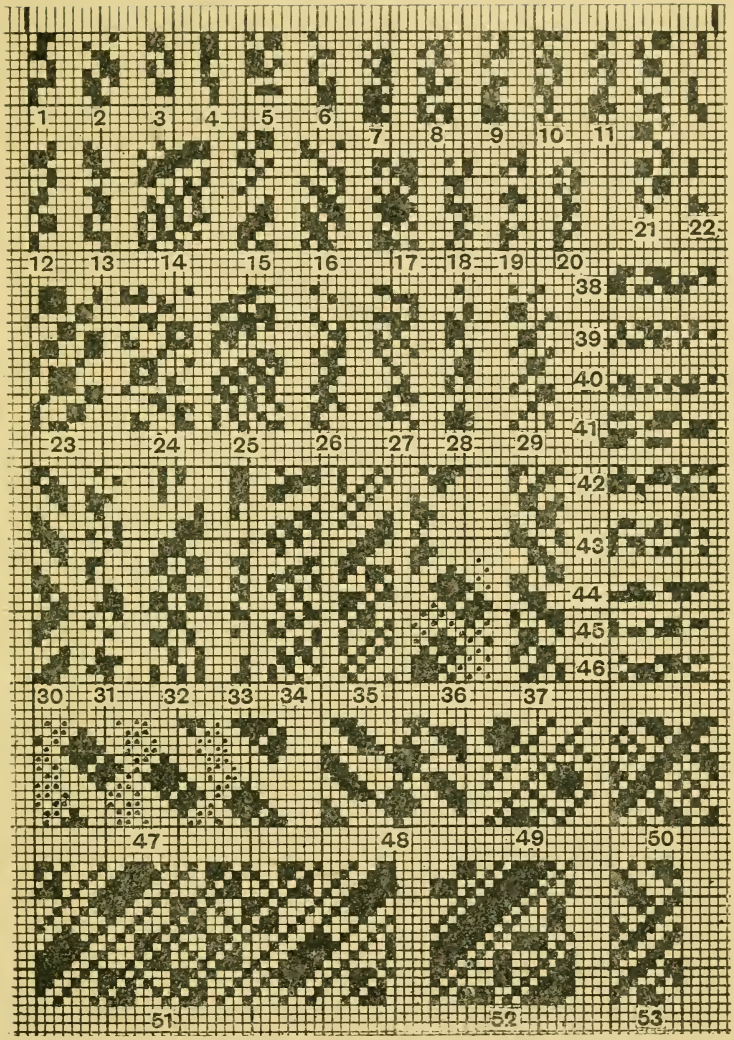

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Plate. 1.

24. What style of yarns and proportioning of warp and weft is necessary to give the best effect in a honeycomb cloth? What objectionable features are developed when the ordinary weaves are used in low quality cloths? Give two examples showing how the weave is modified to suit the latter conditions.

25. What are "Brighton" honeycomb weaves, and in what respects do they differ from the ordinary honeycomb? Give two designs, and show how coloured threads can be effectively introduced.

26. Give two designs for "sponge" weaves. Explain their features and principle of construction, and suggest fabrics suitable for their application.

27. Describe the features of cloths woven by crêpe, oatmeal, and granite weaves. Give a design for each class, and state the style of yarns necessary to give the best effect in each class; also describe the method of construction adopted in each case.

28. Give designs illustrating different types of weaves suitable for towelling fabrics. Name the features which you consider renders each type suitable for the purpose.

XIV.—DRAFT AND LIFTING OR PEG PLANS.

1. What is meant by the processes termed "looming" or "twisting" and "drawing-in"? Name the circumstances under which one method is used in preference to the other. Explain the forms of drafting known as "straight," "centred," "mixed," "skip," and "spaced."

2. Make a sketch showing the position of the lease rods, healds, and beams in the drawing-in and twisting frames. Also explain the means adopted to aid the picking up of the threads and heald eyes in rotation.

3. What is meant by the term "drafting"? Name the principle forms of drafts, and give examples of designs for which each form is applicable.

4. A warp is drafted on four shafts in "skip" order. Give peg plans to weave calico, 2/2 twill, 2/2 matting, and satinette.

5. Give drafts and lifting or peg plans for the following designs on Plate II.:—

(*a*)	Design 54.	48 ends	8 picks		(*f*)	Design 61.	60 ends	10 picks	
(*b*)	,, 55.	50 ,,	10 ,,		(*g*)	,, 65.	16 ,,	16 ,,	
(*c*)	,, 58.	56 ,,	8 ,,		(*h*)	,, 69.	40 ,,	40 ,,	
(*d*)	,, 59.	58 ,,	10 ,,		(*i*)	,, 70.	34 ,,	24 ,,	
(*e*)	,, 60.	54 ,,	6 ,,						

6. Design 57. Fill in a calico ground, and give the draft and peg plan.

7. Design 62 has some marks omitted, supply these and give the draft and peg plan for the perfect design.

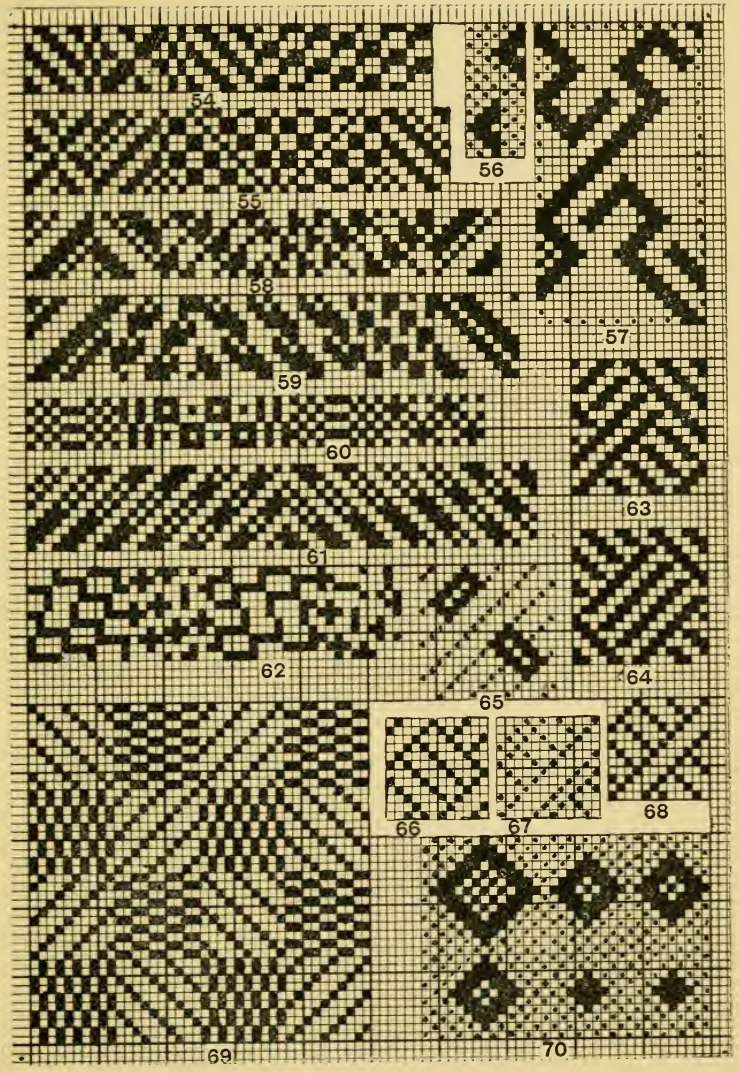

PLATE II.

8. Give the best drafts and peg plans for designs 63 and 64. Also describe the basis of construction, and make another design on the same plan.

9. Give what you consider to be the best drafts for designs 66, 67, and 68. State the reason for your arrangement in each case.

10. Peg plan 56. Supply two suitable drafts and give the resulting full designs.

11. Give the full designs resulting from the following:—

(*a*) Draft 71 and $\frac{3}{3}$ twill tappet.

(*b*) ,, 72 and peg plan 74. Also make a larger design of the same style, keeping to the same number of shafts.

(*c*) ,, 77 and peg plan 73. State class of pattern produced.

(*d*) ,, 75 and adjoining peg plan. Also rearrange the draft and peg plan so that the same design can be produced with a regular twill tappet.

(*e*) ,, 76 using, first, a twilled mat as peg plan, and second, any suitable twill.

(*f*) ,, 78 and peg plan 79.

(*g*) ,, 80 and peg plan 83. Also give another draft applicable to the same peg plan, and another peg plan applicable to the same draft.

(*h*) ,, 81 and peg plan 84. Suggest a cloth for which the design would be suitable, and write out a warping pattern for it.

(*i*) ,, 86 and peg plan 85.

(*j*) ,, 87 and peg plan 88. In the latter plan horizontal spaces represent shafts and vertical ones picks. What advantage has this method over that employed in the previous examples?

12. Give two peg plans and suitable warping patterns for draft 82 to use for a shirting fabric. Also give another draft which would suit the same peg plans.

13. Give three peg plans which would produce "stripe," "mock check," and "spot" designs respectively when woven with the following draft:—

Ends	1 to 16	straight	draft	on shafts	1 to 4
,,	17 to 32	,,	,,	,,	5 to 12
,,	33 to 48	,,	,,	,,	1 to 4
,,	49 to 52	,,	,,	,,	13 to 16

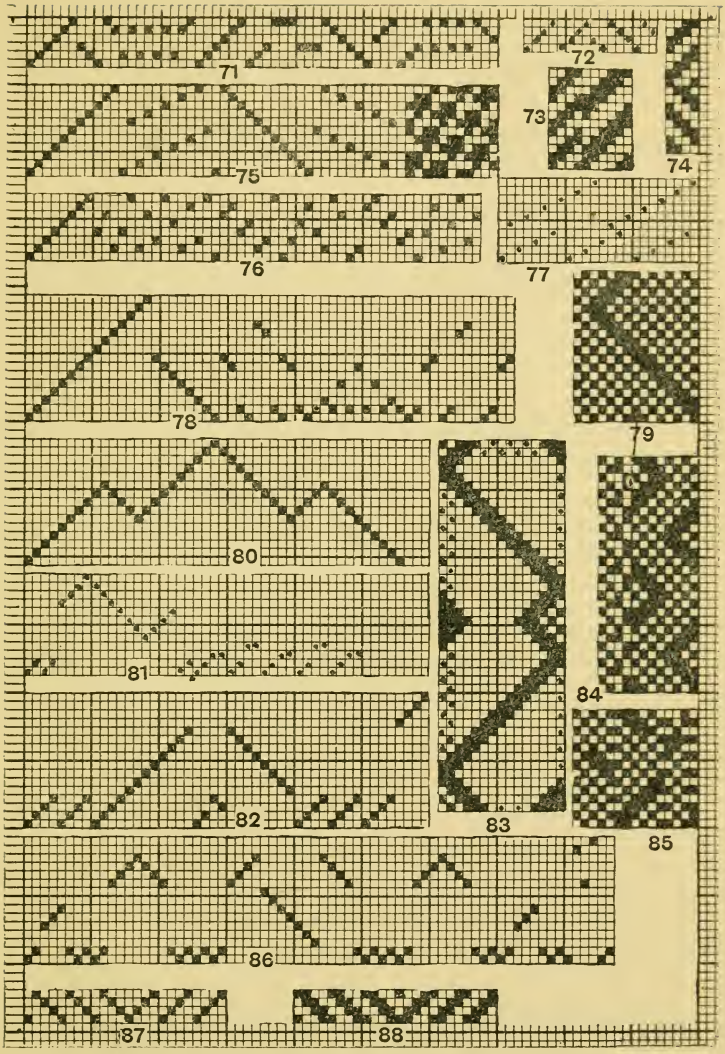

PLATE III.

XV.—STRIPE AND CHECK DESIGNS.

1. Make three stripe designs using calico, 4-shaft warp satinette, and 4-shaft weft satinette. Give drafts and peg plans.

2. Make a stripe design, showing three effects, using a $\frac{3}{2}\frac{1}{1}\frac{2}{2}$ twill as basis. Give draft and peg plan.

3. Mark out stripe designs as follows:—

   (*a*) On 40 ends using $\frac{3}{1}\frac{1}{3}\frac{1}{1}$ twill and two rearrangements.

   (*b*) Using three of the following weaves:—Calico, 3-shaft twill, 2/2 twill, 8-end honeycomb, 8-end diagonal, and 5, 8, or 12-end satins.

   (*c*) Herring-bones, using only 4 shafts, and using 8 shafts.

   (*d*) Comprising four distinct effects, and using only 4 shafts.

   (*e*) Consisting of 16 ends calico, 8 ends satinette, 16 ends calico, and 8 ends of any suitable weave.

   (*f*) Using calico and weaves 99 and 100.

   (*g*) Using calico and weaves 101, 102, and 103.

4. Make check designs as follows:—

   (*a*) On 24 × 24 using 4-shaft twills, also on the same repeat using 4-shaft satinette.

   (*b*) On 30 × 30 using 5-end satins.

   (*c*) On 32 × 32 using 2/2 twills to right and to left and 2/2 matting. Give the draft and peg plan.

   (*d*) On 36 × 36 using weaves 115 and 116.

5. Make a 32 × 32 check design on the following plan:—

24	8
A	B
C	A

Using weave 117 for A, weave 118 for B, and any other suitable weave for C.

6. In making stripe and check weave designs what are the important points to be observed to ensure good results in structure and design? Describe the effect upon the cloth if these points are not observed, and give one or two examples of good and bad arrangements.

7. Make a design on the basis of weave 104, taking each square to represent 4 ends and 4 picks, and using 3/1 twills for the solid squares therein and 1/3 twills for the blanks.

8. Construct a design on 32 × 32 using Fig. 105 as basis. Develop full squares in 2/2 twill, dots in 2/2 mat, and blanks in 1/3 twill.

9. (*a*) Use Fig. 106 as the basis for a new design, each square to represent 8 ends and 8 picks; develop full squares in weave 107 and blanks in weave 108. (*b*) Use Fig. 109 as basis and apply weaves 110 and 111.

10. Make a design on the basis of Fig. 112, each square to represent 4 ends and picks. Select weaves suitable for the crosses, dots, full squares, and blanks.

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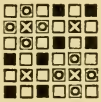

11. Combine weaves 113 and 114, (*a*) end and end; (*b*) pick and pick; (*c*) as a check design, using 24 ends and picks of 113 and 8 ends and picks of 114.

12. (*a*) Make a design on 48 ends and 12 picks, to weave with 12 shafts, suitable for Oxford shirting; (*b*) a design on any repeat for Harvard shirting to use 14 shafts. In each case give the draft, peg plan, and a suitable warping pattern.

13. What is the object of weaving two or more ends in a heald in Oxford shirting and nurses' dress material? Give reed, pick, yarn counts, design, and warp patterns suitable for each purpose.

14. Mark out two designs to repeat on 16 × 16, one in imitation of Fig. 144, and one of your own formation.

15. Mark out the weave of the cloth represented at Fig. 146, Plate V. Also make two other designs of the same style on different numbers of ends and picks.

16. Mark out the warping patterns, drafts, and peg plans to reproduce the Harvard shirtings represented at Figs. 147 and 148.

17. What would be the effect in cloth of weaves 131, 132, 133? What reed, pick, and yarns would you use in each case? Suggest suitable uses for each, and briefly indicate how further ornamentation could be introduced into them.

18. If you used the crêpe weave Fig. 133, 2/2 twill, and the 7 and 1 mock leno in a cloth with 80 ends and 80 picks per inch of 40's twist and 40's weft, how would each weave affect (1) the feel, and (2) the appearance of the cloth?

XVI.—SPOT AND EXTRA MATERIAL DESIGNS.

1. Arrange the spot figures on Plate IV. as follows:—

(*a*) Fig. 119 in 5 satin order on 20 ends and 20 picks. Apply 5 satin ground.

(*b*) Fig. 120 in 6 satin order on 48 × 48. Use 2/2 twill ground.

(*c*) Fig. 121 in 5 satin order on 30 × 30. Apply a suitable ground. What fault would develop in the design and how would you correct it?

(*d*) Fig. 123. Eight spots on 56 × 56 in the order of Fig. 124. Apply a suitable ground.

(*e*) Fig. 125. As a weft figure on 48 × 48 in the order of 6-end broken satin. Turn the figures in different positions so as to prevent a stripe effect. Add a suitable ground and work it round two of the figures only.

2. Set out a spot design of your own formation on 32 × 32 and apply a ground to give the best effect to the spot in an 80-reed cloth.

3. A spot figure is arranged in 5 sateen order on 80 × 80. It is desired to rearrange it in 8 satin order and still maintain the same area between the spots. What must be the repeat of the new design?

4. Arrange Fig. 128 as a weft figure in alternate order on 24 × 24. Also give designs showing the arrangement of 5 and 8 figures respectively, keeping the same area for each spot as in the first design.

5. Set out Fig. 126 in plain order on 32 ends and picks of plain ground, to weave as an extra weft figure picking 2 ground, 2 figure.

6. Arrange Fig. 127 as a two-colour extra weft spot, developing full squares in one colour and dots in the other. Use a plain ground, pick-and-pick wefting, and let the design show two figures in alternate order.

7. Set out Fig. 128 to weave as an extra warp figure using one colour of warp for the rectangle and another for the diamond. Show two figures in alternate order with 8 ground ends between each figure.

8. Fig. 129 represents one-quarter of a centred pattern. Complete the same and arrange it to weave as an extra warp figure on a plain ground, 1 end ground to 1 figure.

9. Make small designs illustrating the application of extra warp and weft. Which is the most economical and satisfactory as regards effect produced in such fabrics as vestings and brocade dress material?

10. Compare the principles of applying "extra" colouring in warp and weft. Work out sectional designs illustrative of each system.

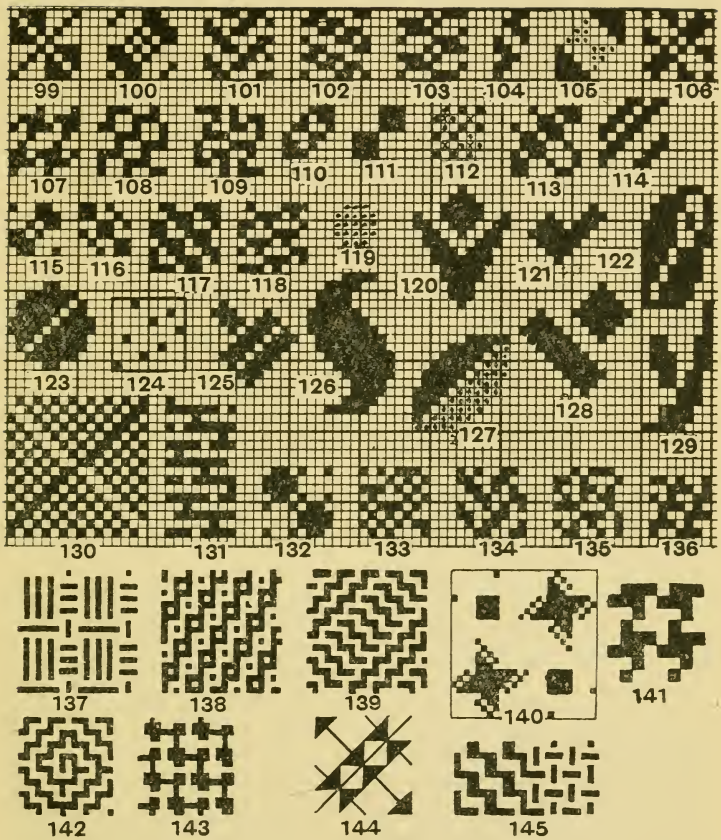
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PLATE IV.

11. Explain the structure and uses of the cloth known as "Dhootie." Mark out a small design and the tie-up for it. Also describe the shedding arrangement by which it would be produced in cloth.

12. Suppose you had to reproduce the cloth represented at Fig. 149, give the design, colours, and order of warping and wefting you would employ. The white spots to be developed by extra warp.

13. Give a design which would produce white crosses on a plain woven black ground cloth as Fig. 150.

14. Give draft, peg plan, and order of colouring to reproduce the cloth shown at Fig. 151, using only one set of warp and one set of weft threads.

15. The same particulars as question 14 for the cloth shown at Fig. 152.

XVII.—COLOUR AND WEAVE EFFECTS.

1. Sketch the effects produced by warping and wefting the plain weave in the following orders:—(*a*) 1 black, 1 white; (*b*) 2 black, 2 white; (*c*) 2 black, 1 white; (*d*) 4 black, 4 white.

2. Supply weaves and colour plans to produce hair line effects in two, three, and four colours.

3. Give warping and wefting plans to produce figured effects in plain, 2/2 mat and 2/2 twill, one for each weave. Show the effect upon the pattern of an error in the warping, drafting, or picking.

4. Sketch the effect produced by the plain weave and the following warping and wefting:—

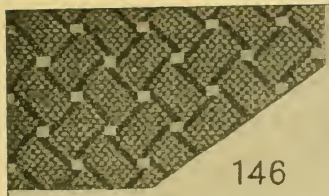
WARP.	WEFT.
1 black } 4 1 white }	1 black 1 white
2 black 1 white } 4 1 black } 2 white	

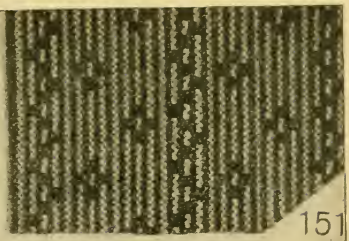
5. The same for the 2/2 mat warped and wefted (*a*) 2 black, 2 white; (*b*) 4 black, 2 white, 2 black, 2 white, 2 black, 2 white, 2 black, 2 white; (*c*) 2 black, 1 white, 1 black, 2 white, 1 black, 1 white.

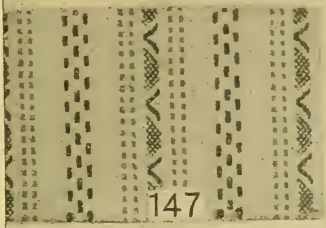
6. Sketch the effect of warping and wefting design 130, Plate IV., 1 black, 1 white.

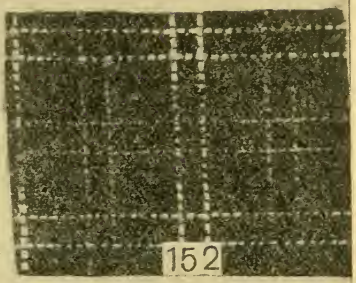
7. Give weaves and warping and wefting to produce effects 137, 138, 139, 141, 142, 143, 145, Plate IV.

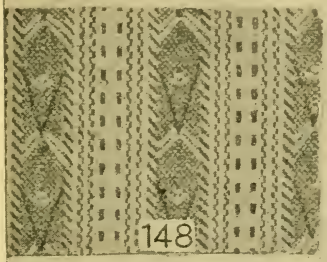
8. Mark out a design on 24 × 24 showing how you would interweave the threads in order to produce a design having the appearance of a black star on a white ground similar to Fig. 140. Assume that the warp and checking patterns are both 8 white and 4 black. Indicate on the design which are the white and which are the black threads.

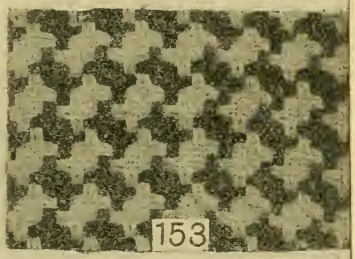


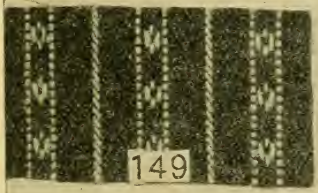


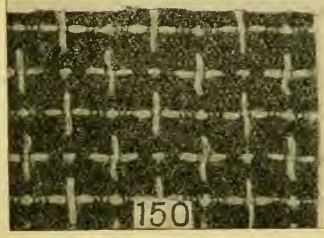












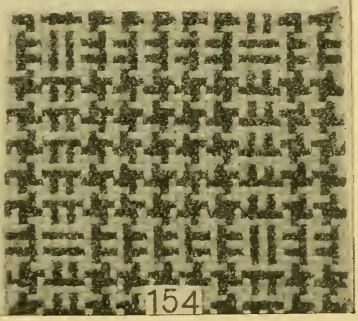


PLATE V.

9. Give the design and order of colouring which you consider would reproduce the cloth represented at Fig. 153. Indicate the coloured threads on the design.

10. The same particulars as in question 9 for the cloth shown at Fig. 154.

XVIII.—BACKED AND DOUBLE CLOTH.

1. Give warping pattern, setting, peg plan, and draft for a striped and backed cotton trousering.

2. Make a design for a backed cotton trousering using weave 134 for the face. Select a suitable back weave and give the reason for your choice. Also give warp and weft pattern and setting.

3. Mark out a design for cotton trousering using 2/2 twill face and 12-end satin back. Give warp and weft pattern and setting which you consider will make a suitable cloth.

4. Put a 4-shaft twill back to design 99, Plate IV., as follows:—

Warp	2-end face. 1 ,, back and for stitching.	Weft	2-picks face. 1-pick back.

5. Put a sateen back and wadding pick on design 135, as follows:—

Warp	1-end face. 1 ,, sateen and for stitching.	Weft	2 face. 1 wadding.

6. Make plan 136 into a treble cloth, as follows:—

Warp	1 face. 1 middle for stitching. 1 back.	Weft	1 face. 1 wadding. 1 back.

7. Give designs to weave (*a*) plain cloth four times the width of yarn in the reed; (*b*) 2/2 twill pillow casing; (*c*) hose piping; (*d*) twill pocketing; (*e*) twill skirt binding.

8. Give draft and peg plan for a double plain cloth suitable for the insertion of wood or metal strips from one side, viz., double cloth bound at one selvage at intervals of, say, half-an-inch.

9. By the aid of sections and designs, illustrate the structure known as double plain. Give designs for (*a*) 2-ply diagonal stripes; (*b*) 3-ply dice effect; (*c*) a 2-warp 3-weft effect, using Fig. 141 as a motive.

10. Make designs and sectional drawings illustrating the following reversible fabrics:—(*a*) One colour warp and two colours weft suitable for carriage rugs; (*b*) two colours warp and one colour weft suitable for dress cloth.

11. Make a design for a figured shawl using a cotton warp and two colours of woollen weft. Show by sections how the two colours are worked on the face and back so as to form the figure and also to hide the warp. Give five pairs of suitable contrasting colours for the weft.

12. Give designs, drafts, peg plans, and denting for twill face Bedford cords to produce ribs of one-sixth and one-eighth of an inch wide respectively. How would you beam the warps, and what do you think would be the relative take-up of each?

13. In what particulars does a pique differ from a Bedford cord? Give designs, and describe two methods of introducing coloured threads into each type.

14. What do you understand by a "pique" fabric? Give the settings for a low quality and a very high quality. Also designs to produce (*a*) simple ribs; (*b*) waved or zig-zag rigs; (*c*) ribs with dots of colour on the surface.

15. By sectional sketches and designs illustrate the difference in structure of low quality and good quality piques, and state the reasons for the difference.

16. Name the various methods of ornamenting pique fabrics. Give designs for two styles, and state the purpose for which each cloth would be suitable.

17. In Bedford cords show (*a*) how solid coloured stripes can be produced, and (*b*) how ornamentation can be obtained.

XIX.—FUSTIAN AND SUNDRY FABRICS.

1. Describe the structure and uses of cloth known as "fustian." Give a design showing the weave of the cloth, also say what is meant by the term "races," and explain their use.

2. Mark out designs illustrating the following makes of cloth :—Swansdown; imperial sateen; tabby back and Genoa back velveteen. Point out the characteristics which distinguish the first two from the last two in their finished condition.

3. Give the drafts and peg plans for a cotton cord and a velveteen. Describe the method of cutting these goods, and say how the knife is guided to its correct position. Explain any feature in the cloth structure which prevents the pile being plucked out.

4. Make designs for corduroy cloth, 1st with plain or tabby back, 2nd with twill or Genoa back. State the reasons for the use of both weaves, and mark on the designs the points where the weft should be cut to form the pile.

5. Mark out designs suitable for a very light cloth and also for a very heavy cloth in both corduroy and velveteen. Give the reed, pick, and yarn counts you would recommend with each design.

6. What are the essential features to be embodied in the construction of a fine velveteen? How can the fabric be ornamented? Give suitable particulars for a good quality of cloth for ladies' dress wear.

7. (*a*) Make a small design for a fancy velveteen to give a check effect, and give the draft and peg plan to weave the same by healds. (*b*) Make a small design for figured velveteen, and describe the shedding arrangement you would employ.

8. Make designs (one of each) for pique, corduroy, and Bedford cords. State the effect produced by each and the points wherein they differ.

9. Make one design for corduroy and another for Bedford cord, each to give cords of $\frac{1}{8}$ in. wide. Give reed, pick, and yarn counts you would use in each case.

10. State the characteristic features of the following cloths:—

(*a*) Oxford shirting, flannelette, velveteen, dhootie, crimp, terry, repp, cellular shirting.

(*b*) Sateen skirting, Harvard shirting, cord trousering, piqué, poplin, broken sateen, zephyr.

11. Define the terms muslin, tartan check, brocade, damask, diaper, and reversible fabrics. Give approximate particulars for each type and the purpose for which it is suitable.

12. Explain what is meant by "one-sided" and "reversible" damask. Make a small design showing the ground weave and method of figuring you would adopt in each case.

13. Explain the structure of "brocade" cloth and the features in which it differs from a reversible damask. In what ways may colour effects be introduced into brocades?

14. Describe the method of designing and arrangement of jacquard mounting and loom equipment you would employ for weaving brocade fabrics with two or more wefts. Illustrate the structure of the cloth by sectional drawings.

XX.—GAUZE OR LENO WEAVING.

1. What is meant by the following terms relating to leno weaving:—Doup, easer, standard thread, half cross, full cross, lace stripe?

2. Sketch a doup heald and explain the method of weaving gauze by a dobby; also the use of a "shaker" and "easer." Under what circumstances would you use a reed with some dents left out when weaving gauze fabrics?

3. Make sketches showing the cross shed and open shed in gauze weaving; also explain how plain cloth could be formed at intervals.

4. Mark out a small design for leno cloth. Give the drafts and peg plans for the same to be woven by top doups and also by bottom doups. What are the relative advantages of the two methods of weaving? For what style of patterns and under what conditions would you choose one or the other method.

5. Why is there more difficulty in working fancy gauze effects in double lift as compared with single lift dobbies? Describe how the difficulty may be overcome and how it is affected by top or bottom doups.

6. Explain the method of weaving gauze in a double lift dobby loom. For what style of leno and under what conditions would a shaker be essential, and when may it be dispensed with? Give two designs for leno net stripes, both to weave in a double lift dobby; one to require a shaker or leveller and one to weave without the latter motion.

7. Mark out or sketch a design for a two-doup leno cloth. Give draft, peg plan, order of denting, and beaming the warps. What difference would you make if the design had to be woven in both single and double lift dobby machines?

8. Mark out or sketch a leno design to be woven by tappets. Give draft and peg plan; also say whether you would use top or bottom doups. Sketch the outline of the tappets to control doup, doup standard, crossing and crossed end shafts. State the possibilities and limitations of tappets for leno weaving.

9. State the principles of leno figuring by the use of only one doup shaft, and its limitations. Give two illustrations showing the possibility of producing variety of effect in this manner.

10. Describe the construction and action of the gauze reed. Name the cloths and give an example of patterns which can be woven in this manner.

11. Sketch and describe the distinctive features of a jacquard and harness specially built for weaving leno brocade. Explain how the crossing of the warp threads is effected and how the cards are cut from the design.

12. Describe the arrangement of jacquard and mounting you would employ to produce (*a*) leno brocade with coloured extra weft spots; (*b*) stripes of leno brocade and white satin; (*c*) stripes of leno brocade and plain cloth with extra warp figuring on the plain portion.

13. Why are empty dents left in the reed in leno weaving? Explain the method generally adopted to emphasise the crossing effect in net lenos. If you know of any arrangement for overcoming the limitation of doup weaving as regards the denting of the threads, briefly describe the same.

14. Give designs, drafts, and peg plans for two distinct mock leno effects; one for a stripe and one for a check.

15. Give three examples of mock leno weaves intended to produce open effects; also a weave which will distort threads in imitation of a gauze or lace stripe on calico ground. In each case give the order of denting and a sketch of the effect you intend to produce.

16. Explain the method of weaving Madras muslin suitable for curtains. Illustrate the structure of the cloth by means of diagrams; also show the method of binding the figuring weft.

17. Make a sketch showing the structure of Madras muslin, and explain how the pattern is formed. Mention any special arrangement for producing the cross shed in this cloth.

XXI.—LAPPET AND SWIVEL WEAVING.

1. Describe a loom fitted with the Lancashire lappet mechanism, and explain the method of working the needle frame. Sketch a lappet wheel arranged for a zig-zag pattern.

2. Sketch and describe the Scotch lappet arrangement for producing spots or figures on the surface of the cloth. Illustrate a form of spot which would require two needle frames, and explain the circumstances under which more than one frame is necessary.

3. Describe a lappet motion in which the needle frames are controlled by a series of pegged lags. Enumerate the advantages of the arrangement, and state the points in which it has proved less successful than the wheel motions.

4. What do you consider to be the respective merits of the pegged lattice and wheel arrangements for controlling the needle frames of a lappet loom? Sketch a pattern requiring three needle frames and also the nearest imitation you could produce by using one frame only.

5. Sketch a lappet wheel for a pattern of your own formation. Explain how the wheel would be constructed and how it determines the pattern on the cloth. Mention any limitation in the form, setting, or spacing of spots, due to the lappet mechanism.

6. What are the special characteristics of ornamentation produced by the lappet frame? Compare the value of the system with doup weaving and with swivel weaving, taking into account economy of production, durability of the cloth, and capacity for ornamentation. Some lappet effects closely resemble those of the doup and others those of the swivel. Carefully describe how you would distinguish each effect.

7. What are the special merits of swivel weaving and the drawbacks to its application to power looms? Briefly describe the principle. How would you distinguish a swivel spot from a lappet?

8. What do you understand by a swivel loom? Describe the mechanical arrangement and point out the distinctive features of swivel weaves. Mention two methods of obtaining an imitation of swivel effects.

9. Describe the swivel shuttle and the mechanism by which it is controlled in any power loom. Mark out a small design which you consider suitable for swivel weaving.

XXII.—TERRY TOWELLING.

1. Explain the structure of a three-pick terry fabric, and show how alternate squares of red and white pile may be formed, and how figured terry is produced.

2. Make a sketch showing the structure of a terry fabric, and explain how the terry may be arranged to form on either side at pleasure; also how cloth entirely free from terry is produced at the end of each hand towel.

3. Make sectional sketches running warp way and showing the construction of terry fabrics—

(*a*) With loops on both sides equally;

(*b*) Loops on one side only.

Why are the pile threads arranged to form pile on the reverse side when not required on the face instead of being run into the body of the cloth as in carpet weaving?

4. Mark out peg plans and drafts, or small complete designs, for three styles of 3-pick terry cloth, viz.:—

(*a*) For cloth with loops at one side only.

(*b*) ,, ,, at both sides.

(*c*) For cloth with loops at both sides, and changing positions after forming six loops.

5. Explain how the pile is produced by mechanical means in a terry towel loom, and how the length of pile is regulated.

6. Explain the timing of the essential parts of a terry towel loom. Sketch a dobby motion for controlling the beating-up and also for automatically changing the lattice barrels to make headings.

7. Illustrate the weave and method of designing for a three-pick figured reversible terry cloth, and explain the arrangement of loom, harness, and jacquard you would employ.

8. Describe the construction of the jacquard and the arrangement of harness used for weaving terry towels (*a*) with plain headings, (*b*) with figured headings.

9. Give the weaves for 4, 5, and 6-pick terry; indicate the beat-up picks, and state the special features and uses of each kind. Explain how "fast" pile terry is woven.

XXIII.—QUILTING AND OTHER COMPOUND FABRICS.

1. Describe the arrangement of harness, healds, and cumberboards, for weaving toilet fabrics, and particularly explain how the shedding differs when weaving "fast backs" and "loose backs." Show the difference between the two styles by sectional diagrams and small designs.

2. Sketch and explain the "drafting," "denting," and "shedding" arrangement you would employ if weaving fast back toilets, and point out any advantages which are secured relative to the saving of cards, or the painting up of the design. Mark out a small design, also a sectional sketch, illustrating the structure of the cloth, and indicate which are wadding picks.

3. Carefully explain and demonstrate the structure of fast backed piques and loose backed toilets. Explain how the pattern is produced and intensified by wadding weft. Give suitable reed, pick, and yarns for each kind of cloth.

4. Explain the structure of the quilting fabric, known as "patent satin." Illustrate the arrangement of the warp threads in the healds and harness, and the manner of operating the shedding.

5. Describe the heald and harness arrangement you would employ if weaving what are known as patent satin quilts. Name the special features of this cloth. How would you proceed to mark out a design for same?

6. Describe the structure and loom and harness arrangements for weaving the quilting known as "Alhambra." What are the advantages of the structure, and how may the effect be varied?

7. Describe the structure and loom and harness arrangements for weaving honeycomb quilts. Show how variety of effect is produced, and give reed, pick, and yarns for a bed quilt and for a table cover.

8. Explain the structure of the fabric known as "Matelasse." Describe the method of designing and the shedding arrangements for this fabric.

9. Describe, and illustrate by plans or sections of designs, the method of binding in Matelasse fabrics where two cloths and a wadding pick are employed.

10. What is the difference between a brocatelle and a matelasse? Describe how the raised figure is obtained in each case.

11. Sketch and explain an arrangement of healds and harness suitable for weaving the quilt known as "The Matelasse." Give a section showing the structure of the cloth, and compare its merits as a quilt fabric with such cloths as alhambras and patent satins.

12. Describe the structure known as double-equal-plain and Scotch or Kidderminster carpets. Explain the arrangement of hooks and needles in the compound jacquard used for weaving this cloth, show the arrangement of harness and comber-boards, and explain how it permits of the design being painted up solid.

13. What style of jacquard and arrangement of harness would you use for weaving reversible Scotch carpets (*a*) ordinary two-ply, (*b*) three-ply, and (*c*) two-warp and three-weft structures?

14. Describe the structure of "repp" fabrics. Mark out small designs illustrating four different methods of developing a figured effect upon a repp ground. State the counts and colours of warp and weft you would use for a figured repp table cloth.

15. Explain what you understand by a "figured repp" fabric. Mention any limitation in the style of ornament applicable to the cloth, or any special feature common to all figured repp fabrics. Describe any arrangement of jacquard or harness which either facilitates designing for repp cloths, or increases the repeat of pattern; and say whether the arrangement you describe can be applied to all figured repps.

16. What do you understand by the term tapestry cloth? Explain the arrangement of harness mounting usually employed, and specify any variation you would expect to find in the harness arrangement intended only for the production of a low quality tapestry as compared with that required for a superior cloth.

17. Explain the structure and method of designing for a 2-warp 2-weft tapestry. Also the arrangement of jacquard and harness you would adopt and the card-cutting instructions you would give. Under what circumstances would you introduce a stitching warp into a tapestry fabric?

18. Describe arrangement of harness and the method of designing for 2-warp 2-weft tapestry. Show clearly how you would ensure the proper binding of both the face and back of the cloth without stitching warp.

19. Point out the distinctive features of tapestry cloth, woven with and without a separate binding warp. State the comparative advantages of each, and any consideration needed when marking out the design in each case.

20. What limitations (if any) must be observed when marking out a design for a 2-warp 3-weft tapestry? Give a small design with card-cutting instructions; each warp to be controlled by a separate jacquard.

21. Describe the structure of Brussels carpets. Also the method of designing and arrangement of harness and loom for weaving the cloth.

22. Describe the shedding arrangement of a loom weaving Brussels carpets. Mark out a small design for these carpets, and give card-cutting instructions.

23. A 5-frame Brussels carpet has 256 loops in the width. The design occupies the full width of the cloth. How many cords will be required in the harness, and how many hooks of the jacquard will be in gear?

24. Compare in detail the structures of Brussels, Axminster, and Kidder. carpets.

XXIV.—CLOTH DEFECTS.

1. Explain what you understand by the terms "harsh or boardy," "spongy," "bare," and "full," as applied to the feel of cotton cloth. Give examples of cloth structure, with counts of materials, reed, pick, and weave. Also name any other special conditions which you consider would contribute in producing the results thus designated.

2. What is meant by the terms "reedy" and "lack of cover," as applied to cloth? Can you suggest any method of setting the loom parts so as to prevent the making of reedy cloth, especially in calico weaves?

3. What are the various causes of reed marked cloth? What is meant by "cover" on cloth? How would you time the three primary movements in a calico loom to give the best results?

4. What is meant by cover in weaving plain cloths? Give an example showing position of warp threads, timing of shedding, picking and beating-up, to give the best results. In your example state definitely the type of cloth.

5. How would you set your healds and shedding so as to make a plain cloth as reedy as possible? Explain why. What change would you make in order to put on a good cover? Which would be the best (*a*) for weaving, and (*b*) for the appearance of the cloth? Describe any special device for improving the cover.

6. Where would you look for the cause of the following defects in cloth, and how would you seek to remedy them :—Thick, thin, and shady places and cracks, wavy or crimped selvages, broken picks, reediness, floats, and oil spots?

7. State the causes of the following defects due to irregularities in the working of the loom, and suggest how you would correct the same :—Uneven or cloudy cloth, cracks or thin places, weft or selvage floats, and lumpy or curly selvages. Give full reasons why you would expect your remedial measures to succeed.

8. Name some of the faults in the appearance of the cloth which may be caused by a negative shedding motion as compared with a positive motion. State how you would proceed to remedy or minimise the same.

9. Enumerate the causes of irregular selvages, and state remedial and preventive measures.

10. State the causes and remedies for the following defects in cloth :—Box marks, crimped selvages, floats, cracks or open places, small loops of weft, and small loops of warp on the surface of the cloth.

11. What are the defects usually found in sateen cloth? State the causes and the remedies in order to put a good cover and smooth surface on warp face sateen cloth.

12. How would you recognise in cloth the difference between—

(*a*) Weft from stained hanks and box-marked weft?

(*b*) Soiled warp threads and splashes or droppings from the dobby?

(*c*) Coarse warp threads and threads woven from bobbins with insufficient tension?

(*d*) Open places caused by irregular take-up and similar defects caused by short lengths of fine weft?

13. Where would you look for the causes of the following faults in cloth, viz. :—Cracks, drags, broken warp, thick and thin places in the cloth, irregular selvages, and irregular wefting? What steps would you take to remedy them?

14. What are the defects caused in cloth when the loom is out of gear, as follows :—

(1) One of the jacks broken?

(2) The picking cone loose?

(3) A heald shaft too low?

(4) A peg or bowl broken in the chain?

(5) A strained or bent shaft in the warp beam?

15. Define the causes of the following defects in woven fabrics:—Warp floats and stitches, cut weft, weft loops, light and dark bars across the width.

16. Describe the defects in cloth which may have their origin in faulty winding, warping, sizing, drawing-in; also in faulty weft and the irregular action of the weft fork.

17. State the defects in cloth which are caused by (*a*) temples, (*b*) weft fork, (*c*) the sley, (*d*) the reed, (*e*) the picking motion, (*f*) the let-off, (*g*) the take-up motion, (*h*) the tensioning of the weft. State as many of the causes and their remedies as you can.

18. What faults in cloth are traceable to (*a*) too much weight on the beam, (*b*) badly-timed shedding? Suggest some of the causes of (1) excessive warp breakages at the selvages; (2) weft floating.

19. What do you understand by "heald traps"? How are floats mostly caused? What is usually the result of a heald cord breaking?

PART III.

WEAVING MECHANISM.

In every case descriptive answers should be accompanied by sketches, whether asked for in the question or not.

XXV.—TAPPET SHEDDING.

1. Describe a hand-loom mounted with long and short levers, jacks, and treadles. How would you cord the levers for a $\frac{3}{1}\frac{1}{3}$ twill? State the conditions under which more treadles than shafts are required.

2. Draw and describe the tie-up or cording plans for a treadle hand-loom working $\frac{2}{2}$, $\frac{3}{3}$, and $\frac{4}{4}$ twills—(1) with single mounting; (2) with double mounting.

3. Make two weaves on 11 and 13-shaft twill bases, and illustrate the order of hand loom treadling to produce variations of the weave, still retaining the original tie-up. Give the weaves produced.

4. Account for the continued use of the hand-loom as a commercial machine, notwithstanding the apparent advantages of the power-loom. Name the fabrics still woven by the hand-loom.

5. Enumerate the principal motions of a power-loom, giving the order in which they operate in relation to one another. Show how motion is transferred from the crank shaft to (*a*) the heald shafts, (*b*) the picker, and (*c*) the sley.

6. Show by a diagram the position of the loom crank at the commencement of the following motions:—(1) Opening of shed; (2) picking; (3) closing of shed; (4) when the weft fork comes into action.

7. When the reed is in contact with the cloth, at what points in their stroke are the following parts:—(1) Both treadles; (2) both picking tappets; (3) the cranks; (4) the weft fork hammer?

8. Under what circumstances is it necessary or advisable to alter the shedding, picking, and beat-up motions in relation to each other, and how are the changes effected? How would you set the first two (*a*) for cloth standing 45 ins. in a 46-in. reed space loom, and (*b*) cloth standing 28 ins. in a 38-in. loom?

9. Assuming you receive a warp for plain cloth with its threads drawn through the healds and reed. Describe how you would proceed to "gait" the same, or prepare the loom for weaving.

10. In shedding, healds are caused to move at a differential rate. What is the object of this and how is it effected? Under what conditions would the eccentricity be increased or diminished?

11. What is meant by dwell of healds? How does the extent of the dwell affect the appearance of the cloth and the weaving qualities of the warp? What would be the result of using a 3-in. bowl with a tappet which had been drawn for a $1\frac{1}{2}$-in bowl?

12. Describe what you consider a good shed for the shuttle to pass through. What length of time in relation to the other parts of the loom would you keep it open? If you consider this time should vary under different circumstances, state what these are and the reasons why.

13. What would be the relative strains upon the warps of two looms one of which runs 100 r.p.m. and makes a 3-in. shed, and the other 90 r.p.m. with a 4-in. shed; the weighting of the warps being the same?

14. Is there any difference in the strain put upon the warp in weaving plain cloth according as the front or back shaft is raised? What devices are used to equalize the strain as far as possible?

15. Describe the functions of the lease rods. How many rods should be used in a loom, and how would they be inserted in each of the following cases:—(*a*) Plain cloth; (*b*) 3-shaft twill; (*c*) 5-end sateen; (*d*) a 10-shaft dobby pattern?

16. Explain the use of lease rods and their influence upon the shedding. How far from the healds would you place them, and what would be the effect of bringing them too close to the latter?

17. In weaving twills a pair of clasp rods are sometimes used in addition to lease rods. Describe them and explain their use.

18. In weaving cloth whose appearance is easily injured by uneven tension due to catches in the warp, what arrangement of lease and clasp rods would you consider best?

19. What is your opinion of negative as compared with positive shedding motions? Give a rough illustration of each type, and point out clearly their respective merits, especially as regards speed of loom, facility of picking, and any special influence each system may have on the appearance of the cloth.

20. What do you understand by the terms "positive," "negative," and "open" shedding? State the distinctive features of each, and give a rough outline sketch of one shedding motion of each kind.

21. Describe the difference between "closed," "open," and "centre" shedding, and explain the salient features of a shedding motion of each kind.

22. Sketch and describe the shedding motion of a tappet loom, showing all the parts from the tappets to the healds.

23. Describe, with sectional drawings, the shedding motion in the Yorkshire tappet loom.

24. A loom has six shafts. Describe any form of tappet or tappets you would use for actuating the shafts. Give an account of the mechanism connecting the driving gear of the loom with the tappets, and state the limits of the designs which can be worked on the loom.

25. Describe the arrangements whereby 2, 3, 4, and 5-pick patterns can be woven in inside treading tappet looms.

26. Three and five-shaft tappet looms are sometimes fitted with :—

(*a*) Inside tappets and top rollers.
(*b*) Outside tappets, bottom jacks, and spring tops.
(*c*) ,, ,, ,, top jacks.

Sketch the arrangement for any one of the three methods, and compare the respective merits or defects of each system.

27. Explain, by means of drawings, how the negative action of a loom tappet is converted into a positive action for shedding purposes in the case of calico, and two-and-two twill. Why is the latter arrangement not suited for any other twill weave?

28. Give drawings of heald roller motions suitable for (*a*) 3-shaft twill, 1 up 2 down; (*b*) 4-shaft twill, 1 up 3 down; and (*c*) 5-shaft satin, 1 up 4 down. Mark the relative diameters on the rollers, and show the positions of (*a*) on three successive picks.

29. Make a sketch showing treadles, tappets, healds, and roller motion for a two-and-two twill in the position they would each occupy with the crank one-sixth of a revolution past the front centre, the second and third staves to be lifted for the next pick.

30. Describe a shedding motion in which stocks and bowls are used to combine the whole into a positive motion. Point out the means provided for increasing the lift of the healds according to their distance from the cloth fell.

31. Draw a set of stocks and bowls for weaving a 5-shaft twill, and compare its action with a spring under-motion. Can the motion be used for an 8-end, 5-shaft honeycomb? Give reasons for your answer.

32. Compare the relative merits of heald reversing motions based upon the compensating principle and those in which springs and weights play a part. Explain the principle of any spring-easing motion.

33. Compare the merits of roller motions, rope tops, and springs for reversing the position of healds in tappet shedding. Fully describe a rope top motion.

34. Fully describe the Lacey top motion, and give your opinion of its va'ue.

35. Describe, with sectional drawings, the shedding motion in the "Woodcroft" tappet loom. What are the advantages of using this class of tappet?

36. Describe the difference between the box-plate and the Woodcroft tappet. How can the latter be arranged to give either an open or a split shed? Sketch a ngle plate for $\frac{3}{1}\frac{1}{3}$ twill to weave by each method.

37. Sketch the various types of sections used to form a Woodcroft tappet, together with rough drawing showing how you would arrange the sections on one plate for a 3 up 1 down, 1 up 3 down twill.

38. Sketch the form of a riser and a sinker segment of a Woodcroft tappet. Explain how the tappet is built up and held together. In building the tappet, why is it necessary to consider whether it is for a right-hand or a left-hand loom? What are the features of an ideal shedding motion, and in what points does the Woodcroft fall short of this ideal motion?

39. Illustrate the method of construction of a Woodcroft tappet. What are the objects of the segments known as "riser dwells" and "sinker dwells," and why are they not more generally used? Compare the merits of the Woodcroft tappet and the oscillating tappet for weaving cords and velveteens.

40. Show setting of a Woodcroft tappet to weave a $\frac{1}{5}\frac{1}{1}$ twill to left. Tappet to be fixed at right hand side of loom, inside treadle coupled to back heald shaft, healds drawn in from left to right commencing with front heald, tappet turning in the direction of the front shaft.

41. Find intermediate carrier wheels for the following tappet gears; and show the wheels properly geared in each case:—

	Picks in Pattern.	Crank Pinion.	Tappet Wheel.
(*a*)	9	24	120
(*b*)	7	24	120
(*c*)	7	20	120
(*d*)	8	20	120
(*e*)	7	40	120
(*f*)	16	not less than 16	120
(*g*)	7	25	150
(*h*)	14	15	180
(*i*)	16	15	200

42. Give a sketch showing the side view of the shedding motion for either a side tappet or under tappet motion, with connections to treadles, jacks, or rollers; also state why it is necessary to give a larger lift to tappet for back heald than front. What lift of tappet would be required for front heald stave of sketch with the following measurements:—Distance of heald from fell of cloth 9 ins.; distance of reed from fell of cloth when shuttle enters the shed $3\frac{1}{2}$ ins.; depth of shuttle $1\frac{3}{4}$ ins., on front side of same.

43. Calculate the lift of tappet for shuttle 2 in. wide, $1\frac{1}{2}$ in. deep; sweep of sley 8 ins.; healds 14 ins. from cloth; treadle 32 ins. long; bowl 24 ins. from pin; half moon $7\frac{1}{2}$ ins.; jacks, 10 ins.

44. For a side tappet give length of top lever at each side of fulcrum when lift of tappet is $2\frac{1}{2}$ ins.; treadle 30 ins.; tappet bowl 20 ins. from fulcrum; shuttle 2 ins. wide, $1\frac{1}{2}$ ins. deep; sweep of lay 6 ins.; front heald 9 ins. from cloth.

45. What lift should a tappet have to weave a plain cloth when the sweep of the sley is $5\frac{1}{2}$ ins., healds 8 ins. from cloth, treadle 24 ins., bowl 16 ins. from heel, shuttle $1\frac{1}{2}$ ins. wide and $1\frac{1}{4}$ ins. deep? What will be the effect upon (*a*) the loom, (*b*) the cloth, (*c*) the warp if a $\frac{1}{3}$-pick dwell tappet be changed for one with $\frac{2}{3}$-dwell?

46. Two looms, one 36 ins. and the other 84 ins. wide, are employed in weaving plain cloth of the same reed and picks. Would you make any difference in the form of the shedding tappets? If so, describe it.

47. State what measurements and other particulars you would require before proceeding to draw to scale a tappet curve. As an illustration, draw one plate for a 5-end satin cloth to weave either at the side of the loom or under the healds. Use dimensions suitable for a 40 in. reed space loom.

48. Draw tappet outlines to weave plain cloth and 2-by-2 twill, using suitable dimensions for a 36-in. reed space loom, and explain what difference you would make in the loom to obtain the required weaves.

49. With following dimensions draw a tappet to weave a twill 3 weft, 1 warp, 1 weft, 1 warp, and say what lift you use. Shuttle 2 ins. broad, $1\frac{1}{2}$ ins. deep, sweep of sley 8 ins., healds 14 ins. from cloth, treadle 32 ins., bowl 24 ins. from fulcrum, half moon $7\frac{1}{2}$ ins., jacks 10 ins., tappet bowl 3 ins. dia. Use a suitable dwell.

50. Draw a tappet for a 9-shaft corkscrew twill, and give the intermediate wheels necessary, taking the crank shaft wheel as containing 40 teeth and the tappet wheel 120. Dia. of tappet barrel 5 ins., bowl $2\frac{1}{2}$ ins., stroke 2 ins. One-third of a pick dwell.

51. Draw $\frac{1}{2}$ size the outline of a positive box-plate tappet to weave $\frac{2}{1}\frac{1}{2}$ twill. Dwell $\frac{1}{3}$ pick. Centre of shaft to nearest point of contact with bowl 4 ins.; lift 2 ins.; bowl $1\frac{1}{2}$ ins. diameter; allow $\frac{1}{4}$ in. clearance for working of bowl.

52. Draw to scale the pattern of a box plate 5-shaft sateen tappet, to work at the side of the loom. Fix your own dimensions; also state any considerations which would influence your decision as to length of dwell.

53. Sketch one plate of a Woodcroft tappet 16 to the round for the following twill to run toward the right hand $\frac{1}{2}\frac{1}{2}\frac{2}{2}$. The tappet is to be fixed at the left side of the loom and to turn in the same direction as the crank shaft.

54. Draw $\frac{1}{2}$ size a Woodcroft tappet to weave a $\frac{3}{1}\frac{1}{1}\frac{1}{3}$ twill. Tappet ring 11 ins. diameter outside, $7\frac{1}{2}$ ins. diameter inside, diameter of plate over all 23 ins.; lift 3 ins.; dwell $\frac{1}{3}$ pick. Mark the direction in which it is to turn and show on riser the position of tappet bowl when the crank shaft is at the bottom centre.

55. Describe the oscillating tappet. Explain how the shedding is effected, and show how you would arrange the pattern chains to weave a 9-pick pattern of your own formation. Sum up the merits of the motion, and state the particular types of cloth for which you consider it to be suitable.

56. Describe a shedding tappet, other than the oscillating tappet, in which the pattern is controlled by chains.

57. Describe a shedding tappet in which the pattern is controlled by pegged lags. Assess its value as a shedding motion and its suitability for any special type of cloth.

58. What is meant by the term "centre shedding motion" as applied to a loom? Give a sketch of such an arrangement, and point out any limitations of its use, due to the character of its action.

XXVI.—PICKING.

1. Illustrate by rough sketches various types of shuttles and their fittings, and say for what particular class of loom or fabric each type is used. Point out any special features which have for their purpose the prevention of snarling weft and the relieving of strain on the yarn as the cop or bobbin weaves down. Why are shuttles made right and left handed?

2. If you had the selection of a shuttle which could be threaded by other means than the suction of the mouth, what would be the salient points which would guide you in your choice, more particularly as regards its reliability, durability, and efficiency for grey, coloured, bleached, or sized wefts? Illustrate by sketch any self or hand-threaded shuttle you are acquainted with, and explain the means whereby evenness of drag may be obtained suitable for each kind of weft named.

3. (*a*) Describe the "picker" in detail, and say what materials is it made from. (*b*) What are the essentials of a good picking band? What fault in cloth was formerly commonly due to the bands? Explain various methods of applying bands, and state how their length is determined.

4. Describe the construction of the shuttle-box of a plain over-pick loom with a fast reed. State the means provided for preventing rebound of the shuttle when it enters the box, and also the arrangement for guiding the picker.

5. Describe the construction and fittings of the shuttle-box of a plain over-pick loom. Give dimensions of shuttle, length of boxes, and depth of shed for any style of cloth you may select, and say what conditions limit the size of each. What would be the result if shuttles of different widths were used in the same loom?

6. What is the form, position, and purpose of "buffers," "buffer straps," and "check straps"? Explain their adjustment, and say what defects may be expected in the running of the loom if they are not properly set.

7. Explain, by sketches, a good over-pick motion. What is the use of the buffer, buffer strap, and picker? What is meant by the buffer getting on the stud? What is the result, and how can it be prevented?

8. Name the essential features of a good picking motion, and say how near the motions in general use approach to your ideals and in what details they fall short of the same.

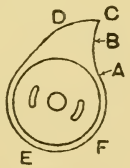
9. Sketch and describe the cone picking motion. Give your opinion of its merits as regards power required, character of motion given to the shuttle, and wear and tear of material.

10. Describe the cone picking motion, and state its merits and defects. In what manner may the force of the pick be increased or diminished, and what is the effect of lengthening or shortening the picking strap?

11. Describe the construction of the picking tappet of a cone or over-pick, explaining the arrangements for repairs and adjustment. Why is the tappet bevelled? How is the pick affected by the shape of the nose bit?

12. Sketch the picking tappet and cone in their relative positions. What position does the picking stick occupy when not in action, and how is it kept in that position?

13. What positions will be occupied by the picker when the picking plate and bowl are in contact at the points indicated by A, B, C, D, E, F in the following sketch?:—



14. Sketch the lever pick arrangement, and explain its action. What kind of picker is used with this pick? How does it compare for economical working with Yates' pick? For what classes of loom and cloth are under-picks advisable or essential?

15. Describe and sketch the scroll picking motion, and say when it is used in preference to the over-pick. State in what type of loom the motion may be found. Compare its action with other under-picks, and say which of its parts are most subject to wear and which to breakage.

16. Explain any means of controlling a picking motion which may cause 2, 3, or 4 shuttles to be "picked" from the same side of the loom in succession. For what class of loom and fabric do you consider it best adapted?

17. Explain the picking arrangement you would prefer for very heavy looms, suitable for weaving belting and hose-piping. Give a reason for your preference, or instead describe minutely the method of picking usually adopted in looms weaving lamp wick, ribbons, and elastic suspenders.

18. Compare the various picking motions in common use as regards (1) the speed of the picker at different parts of its course; (2) momentum, friction, and reaction; (3) cleanliness and handiness; (4) wear and tear. Sum up the merits and defects of each, and say which you prefer for the work you are acquainted with, and why.

19. Compare the merits of picking motions which receive their power from the crank shaft, viz., loose finger and scroll picks, with those which receive power from the second motion shaft, viz., side lever and cone picks; as regards (1) character of motion given to shuttle, (2) consumption of power and economy in working. Consider both wide and narrow and fast and slow looms.

20. Give an account of the various points to be attended to in order that the picking motion of a plain loom may be kept in first-rate order. What is the reason for so much wear and tear in the motion? What defects arise from too strong or too weak a pick? What is the effect of variations in the speed of the loom upon the pick?

21. State the causes of the following:—Shuttle flying out; weft slipping off the bobbin or cop; cop breaking; and thick and thin places across the cloth.

22. Name some of the causes of an uneven running shuttle. Also name the different types of shuttle-guards in use, and fully describe the one which you consider to be the most satisfactory for any particular loom, which must be mentioned.

23. What causes tend to make the shuttle fly out of the loom, and what are the remedies? What measures may be taken (particularly in the shuttle-box equipment) to assist the shuttle in keeping to the race board?

24. What is the result of picking the shuttle too soon, and too late? What defects are caused in the cloth by the shuttle and by the pirn in the shuttle?

25. Describe any automatic motion which has for its object the replenishing of the weft in a power-loom. Point out any merits or demerits which such a motion may have.

26. Describe any device you may know of for automatically changing the shuttles, and discuss its merits.

27. In some of the automatic weft-supply looms the bobbins are changed, and the same shuttle is used throughout, while in others the shuttle is changed and a number of shuttles are in use for one loom. Give your opinion of the respective merits of the two systems.

28. A loom running 80 picks per minute has to be speeded-up to 100 picks per minute. The line shaft drum is 14 ins. dia., and the loom pulley 16 ins. (*a*) Say which you would alter, and give size. (*b*) State the result on the picking motion and shuttle and how you would correct it.

XXVII.—BEATING-UP.

1. Describe the construction of the crank-arm of a loom. Name any defects which a loose-fitting arm may cause to appear in the cloth, and explain the method of adjusting the arm in order to compensate for any wear in the crank.

2. What is the purpose and cause of the variable motion of a loom sley? How can the eccentricity be increased or diminished, and how may it influence the beat-up, picking, and shedding of the loom?

3. Explain why the crank-shaft of a loom is always placed at a lower plane than the connecting pin on the sley sword. What is the usual position of the latter relatively to the rocking shaft when the reed is in contact with the cloth? Under what circumstances is this position varied, and why?

4. Sketch crank-shaft, connecting arms, sley sword, and rocking rail of a loom, with the crank at top centre. Looms for heavy work often have large ears cast to the sley swords, whilst for light work the crank arms are coupled direct to the swords. Explain the reason for the difference.

5. Draw a diagram showing the relative position of swords, connecting rods, and cranks in a power-loom. Show from your diagram the length of the pauses in the movement of the swords, and explain the use which is made of them in weaving.

6. The length of a loom crank is 3 ins., the connecting arm 12 ins., and the distance from the rocking shaft to the connecting pin 28 ins. Draw a diagram to show their relative positions to secure a good beat-up and sufficient time for the passage of the shuttle.

7. Describe, by the aid of a diagram, the effect upon the working of a loom if the existing 12-in. arms were replaced by 9-in. arms and the difference made up by adding 3 ins. to the ears behind the sley swords. How would an increase or decrease in the throw of the crank affect the above?

8. In two looms which run at the same speed and are alike in every other particular, but one having a 6-in. sweep and the other 7½-in. sweep, what is the relative force of the respective sleys in beating-up the weft? Will an alteration in the tension of the warp interfere with the effectiveness of this force? If so, how and why?

9. Two looms are running the same number of picks per minute, and the moving parts of the sley are the same. One loom has a 3-in. crank and a 12-in. arm, the other has a 4-in. crank and an 11-in. arm. Give the force exerted by the latter in beating-up, calling the force exerted by the former one.

10. In the construction of a loom sley, say for both over and under-pick looms, what precautions are taken to induce the shuttle to keep to the race-board, at the same time bearing in mind the satisfactory working of the yarn? Can you give any reasons why a shuttle may eventually wear round at the back and bottom? What steps would you take to reduce the amount of such wear? Does the evil (if you consider it such) exist more in the over than the under, or crank-pick loom?

11. Describe the mechanism for giving two beats of the reed for one pick. Name the fabrics for which the arrangement is required.

12. What are the reasons which determine the bevel of the "sley" of a loom? Make a sketch showing approximately the angle which the reed makes with the shuttle race.

13. At what angle should the reed be when in contact with the cloth, and what difference would a greater or less angle produce in the cloth?

XXVIII.—TAKING-UP MOTIONS AND LOOM PRODUCTION.

1. (*a*) Make a drawing of the ordinary positive take-up motion, showing the essential parts in their proper relative positions, and marking the number of teeth in each wheel. (*b*) Describe the motion, and say in what respects it is not strictly positive in its action.

2. Sketch and describe the Pickles take-up motion, and explain fully its advantages over the older type of motion. State the correct setting of the catch relatively to the shedding and beating-up, and say whether you prefer a pushing or a pulling catch. Give reasons for your answer.

3. Describe a continuous take-up motion. Compare its merits with those of the ordinary intermittent motions in general use, and name the cloths or looms for which it is used.

4. What is a "negative" take-up motion? Under what circumstances is it used, and for what styles of cloth? Draw and describe a motion of this type, and explain how the number of picks per inch is regulated.

5. What style of taking-up motion would you use for each of the following cloths:—Ordinary cotton goods; fustian cloths; quiltings; low-count waste weft cloths; terry towelling; and silk fabrics? Give the reasons for your answer. What defects in cloth are attributable to the take-up motion?

6. Explain any device which has for its object the prevention of thin places in cloth after breakage of the weft. Also describe how you would regulate the take-up in fabrics requiring irregular wefting, *i.e.*, when certain picks require to be crammed closer together than others.

7. What is meant by the term "dividend" of a loom? For what purpose is it used, and why is it necessary to add or subtract a small percentage of the calculated dividend? Give an example to show your method of calculating the dividend, and say whether you consider the weighting of the warp has any influence upon the accuracy or regularity of the picks.

8. Draw a 5-wheel and a 7-wheel gear, each to give 19 picks per $\frac{1}{4}$ in., or the nearest possible thereto. For the former motion, what circumference of emery beam would be required to put in 21.75 picks per quarter, when the beam wheel has 75 teeth, stud wheel 120, little pinion 15, change wheel 24, and rack wheel 48 teeth? Show the influence which a difference of $\frac{1}{4}$ in. in the dia. of the beam has upon the number of picks.

9. Describe the difference between Pickles's, Whittaker's, and the ordinary take-up motion. In what manner may the latter motion be altered to give some of the advantages of the first two motions, and why is it not adopted?

10. A take-up motion is giving 10 picks per inch with an 80's ratchet wheel moving two teeth at a time and a 42 pinion. What pinion would you use to give 17 picks per inch (*a*) without altering the movement of the ratchet; (*b*) by moving the ratchet wheel one tooth at a time?

11. If a 24 pinion gives 33 picks per $\frac{1}{4}$ in., what pinion would be required for 108 picks per inch, and what would be the dividend of the motion? Also if 60 picks per inch are obtained by a 35 pinion, what picks would a 30 pinion give?

12. Calculate the "mathematical" and the "practical" dividends of the following gears. Is there any advantage in having a large or a small dividend?

Rack wheel	50	50	60	60	60	50	60
Beam ,, ...	75	75	60	75	75	90	120
Stud ,, ...	120	100	100	120	100	146	120
Little pinion ..	15	12	12	15	12	14	20
Beam circ.	15″	15″	15″	15″	15″	15″	14″

13. Calculate the item marked x in the following take-up motions. (2/60 = 60 ratchet moving two teeth at a time. "Glass" = Scotch glass 1/200 of 37 inches.)

Ratchet.	Change Pinion.	Stud or Carrier.	Carrier Pinion.	Beam Wheel.	Beam.	Picks.	Div.
50	x	120	15	75	15 in. cir.	90 inch	
50		120	15	56	$14\frac{3}{4}$ in. cir.		x
40	26	120	15	75	x	20 quarter	
40	30	120	15	120	12 in. cir.	x	
60	x	125	19	125	14 in. cir.	60 inch	
2/60	x	120	20	120	12 in. cir.	64 inch	
60	42	120	15	75	15 in. cir.	x glass	
40		120	20	120	4 in. dia.		x
2/80	x	60	30	84	$4\frac{1}{2}$ in. dia.	$10\frac{1}{2}$ inch	
55	x	120	20	120	$4\frac{15}{16}$ in. dia.	14 glass	
2/84	x	72	36	80	4 in. dia.	28 inch	

14. Explain how you would calculate the production of a loom. Name all the factors which you think affect the turn off.

15. What is the number of effective picks per minute made by a loom which runs 180 picks per minute and turns off 5 pieces of 36 yards each with 80 picks per inch, per week of 55 hours' running?

16. How long will it take a loom which has a take-up motion arranged as follows to weave a piece of cloth 60 yards long, allowing 20 per cent. for stoppages:—Beam wheel 75 teeth, ratchet 80, stud 120, pinion 15, change pinion 50, feed roller 15 ins. circ.? The loom pulley is 8 ins. diameter, and the drum on line shaft (which runs at 120 revs. per min.) 14 ins.

17. Find production per 55 hours of 10 looms driven and fitted up as follows:—Line shaft 90 revs. per min., 15 in. drum, loom pulley 10 ins. Take-up motion:—change wheel 50 teeth, ratchet 60, inter. 120, inter. pinion 19, beam wheel 125, 15 ins. circumference. Calculate 84 per cent. efficiency.

18. With line shaft 120 r.p.m., drum 14 ins. dia., loom pulley 8 ins., belt slip 8 per cent., what would be the earnings per 55 hour week, allowing 20 per cent. for stoppages, at the rate of threepence per pick per $\frac{1}{4}$ in. per 120 yards of cloth?

19. What are the chief causes of stoppages in a power-loom? State your ideas as to the best means of obtaining the maximum production as the loom now exists and what improvements you think could be made in its construction with the same object?

XXIX.—LET-OFF MOTIONS.

1. What is meant by "pace" or "set" on the warp? Show how it is regulated and uniformly maintained during weaving. What is the effect on the cloth of too much or too little weight on the warp?

2. Describe the let-off motion in general use for cotton goods. What adjustment is required as the warp weaves down, and why is this adjustment necessary? Show both single and compound levers in your sketches, and state the advantage of the latter arrangement. Compare the use of ropes and chains, and say under what conditions each is the more advantageous.

3. Describe the principle and working of any positive warp delivery motion. Name its advantages and the styles of cloth for which it is specially suitable. Why is it not applied to all looms? Name the defects which may arise in the cloth from irregular delivery of the warp or from improper tensioning.

4. Describe any semi-positive or positive let-off motion for loom warps. Compare the system with any pure negative type, and say for what particular class of cloth you would adopt either motion. Say what results you would anticipate as regards regularity, density of cover, and elasticity of fabric.

5. Give a sketch of a vibrating back rest; illustrate how the motion is set when the healds are at open shed. Compare its merits with a stationary back rest, and say for what kind of cloth the vibrating rest is unsuitable.

6. Describe the principle and action of any arrangement for stopping the loom in the event of a warp thread breaking. Under what conditions are they used, and what limitations do they impose upon the style of cloth and quality of yarn?

7. Sketch and describe an automatic warp stop motion for a loom. State, as far as you can, any advantages gained and disadvantages created by its use, as compared with a loom not fitted with such an appliance.

XXX.—MINOR MOTIONS OF THE LOOM.

1. Describe the object, mechanism, and working of the weft fork of a loom. State its deficiencies as a perfect motion, and also the damages to the cloth which are liable to be made by its application.

2. Describe the weft fork motion; give the timing and setting of the same, and enumerate the causes of the motion acting inaccurately.

3. Name the essential features of a good weft fork. What are the merits claimed for the Pickles tandemite weft fork and a cat-gut grid?

4. Why does the weft fork hammer only receive motion once every two picks? Where should the loom crank and shuttle be when the cam for working the hammer comes into action? Give some reasons for (*a*) the loom stopping without the weft having broken; (*b*) the loom not stopping when the weft has broken.

5. Name the parts of a loom accessory to the weft fork, say why they are necessary, and fully describe the mechanism which is designed to prevent the formation of thin places in the cloth in the event of the weft breaking and the loom continuing to run two or three picks before stopping.

6. Compare the merits of side and centre weft fork motions. Why is the latter type used, and for what styles of looms and fabrics are they required? Describe a centre motion, and sketch the parts in position with the weft broken.

7. Sketch and describe the action of the warp protector motion of a loom either for the loose reed or the fast reed principle. Explain the use of such motions, and state any general causes which may render them inaccurate.

8. Briefly state all the points of difference between a fast reed and a loose reed loom so far as the construction of the sley and the action of the stop rod are concerned. Explain the precautions required in their construction and use and the circumstances under which each is preferred.

9. (*a*) Sketch the loose reed motion showing the parts in position with the shuttle trapped in the shed; (*b*) the same for the fast reed motion.

10. Describe the shuttle box swell and all its uses and connections for both fast and loose reed looms. Also describe an arrangement for relieving the swell of the weight of the stop rod finger at certain points in the stroke of the sley. State the object of the same, and give your ideas as to its value. Are swells fitted to all looms?

11. Sketch and describe the brake mechanism of a loom, showing when and how it is brought into play, and pointing out any defects which may arise in the cloth if the motion does not work correctly. Carefully define the object of the motion.

12. Why are temples used in a loom, and when are they unnecessary; describe any two kinds, and name the cloth defects due to faulty temples or to improper setting, together with the remedies for the same.

13. What are the respective merits of bar, roller, and ring temples; also of flat, round, and angle-shaped temple bars? Also describe the various methods of supporting temples in the loom, and account for the construction adopted in each.

14. Describe the various kinds of temples in general use. Point out their respective merits and uses for the different types of fabrics you name. Explain any special feature of construction whereby they are expected to prevent defects in the cloths for which you say they are adapted.

15. Enumerate the chief cloth defects due to the use of temples. Give remedies for the same; also state the causes of slack selvages, and say whether temples ever tend to the formation of such.

16. What kind of temples would you use for each of the following styles of cotton goods:—Very light plain cloth; heavy quiltings; sail cloths; terry towelling; warp-faced shirting; self-coloured cloth; linings and other goods with polished yarns; fustians? In each case give the reason for your selection.

17. How are selvages ordinarily formed in cloth? Enumerate the special arrangements, and fully describe one of the same, which are used when the ordinary method does not produce a satisfactory selvage, or when it is desired to weave several pieces in a width.

18. What provision would you make for forming the selvages of the following cloths:—5-end sateen; 2×2 mat; 3×3 mat; a 4-shaft diamond such as that produced by draft 87 and peg plan 88, Plate III.; and circular pillow casing?

19. Five-end sateens are often woven with a plain selvage. Describe the various methods of accomplishing this, and state the merits or defects of each.

20. Briefly name several and fully describe one method of weaving a fast centre selvage. Also say what you consider important practical details which ought to receive attention in the preparation for, or the weaving of, ordinary single width goods in order to ensure a good selvage.

21. Describe the method of weaving centre selvages with a doup, and also an arrangement for producing the same result in a more perfect manner. Sketch the appliances in position with the loom crank at or about the bottom centre. State how you would control the selvage ends, and whether separately or from the same beam as the warp and why. Also show the nature of the selvage so formed, and discuss its value and strength.

22. Name the parts of a loom which are subject to the most wear and tear. What peculiarities in the motions of a loom render it more liable to these actions than other textile machinery?

23. What are the parts of a loom which most frequently get broken or out of order? What are the reasons for the same, and how may they be reduced? Name the chief improvements which have been made in the construction of plain looms within recent years in this direction.

24. Name the causes of (*a*) the loom knocking-off or stopping; (*b*) weft floating or stitching; (*c*) uneven let-off.

XXXI.—SHUTTLE-BOX MOTIONS.

1. Describe the details of the shuttle-boxes of any drop-box motion, the form of picker employed, and how the latter is kept clear of the boxes; also the position of the picker spindles and the means of preventing rebound of the shuttle.

2. Examine the respective merits of the following box-motions as regards suitability for style of loom, cloth, and pattern :—Diggle's, Wright Shaw's, eccentric and circular.

3. For Diggle's box-motion describe the details of the boxes and picker and arrangements for keeping the latter clear of the boxes. Also for adjusting the level of the boxes and the pattern. Give the timing of the motion in relation to the shedding and picking.

4. Describe Diggle's box-motion. How many kinds of links are necessary for the operation of four boxes in any conceivable manner? Indicate how you would box the shuttles for the following pattern, and sketch the chain of links required. Also explain how the latter are adjusted after the action of the weft fork.

Blue.....	8	8		2		30 picks
Red	2					
White	2		2		2	
Sky		4				

5. Describe the Wright Shaw box-motion. Show clearly how damage is prevented in the event of the shuttle or picker trapping in the boxes, and how the latter are locked in position after each change. Name the styles of cloth and pattern for which you consider the motion suitable.

6. Describe the Eccles eccentric box-motion. What difficulties are encountered in laying the cards and in producing perfect checkings in the cloth? Explain how you would proceed to time and set the boxes in relation to the shedding, picking, and race board.

7. Describe an eccentric box-motion which is designed to simplify the building of card chains and the avoidance of broken checkings.

8. Explain the construction, special features, and advantages of the Knowles box-motion. What difference is made between a 4-box and a 6-box motion?

9. Describe a 6-shuttle eccentric box-motion. State its merits as a checking motion, and sketch the chain of cards for the following pattern.

White	4		4	2
Blue	2	2		
Sky	2	2		
Red			2	
Pink			2	2

10. Describe the following details of the circular box motion, and account for the construction adopted :—(*a*) Box supports; (*b*) for preventing over running and rebound of the boxes; (*c*) for checking the shuttle and ensuring its proper position for picking; (*d*) for preventing damage in the event of the picker or the shuttle not clearing the box or the shuttle not fully entering it, or in the event of both hooks engaging at the same time.

11. Sketch the main features of a revolving box-motion for 6 shuttles, and explain what provision is made in a loom so equipped for the protection of the warp should a shuttle fail to enter the box properly. What are the limitations of the motion as regards style of cloth and checking?

12. Describe the circular box-motion, and give sketches showing the construction of the boxes and the method of locking them in position when changed. How would you arrange the colours in a 6-box cylinder for the following pattern?:—

White	10	2	10
Blue	2	2	
Sky			4
Red			2

13A. For a circular box-motion give the boxing and a plan of the cards for the following checkings:—

a	*b*	*c*
6 orange	4 red	8 blue
2 white	2 white	2 red
2 blue	6 blue	2 white
6 orange	4 white	8 pink
4 red	2 red	4 sky
2 blue	2 white	2 white
2 orange	2 blue	2 blue
2 blue	2 white	2 white
26	24	30

13B. How would you arrange the checking in a circular box loom to weave cloths with 40, 70, and 100 picks per inch respectively, using a 60-reed Stockport counts? The checking to agree as near as possible in size and colouring with the following warping plans:—

d	*e*
100 red	72 blue
30 green	6 white
6 white	12 red
8 black	9 black
6 yellow	12 red
12 black	6 white
24 blue	56 blue
12 black	15 red
6 yellow	15 white
8 black	21 blue
6 white	15 white
30 green	15 red
248	254

14. Draw a diagram illustrating the principle of the circular box check motion. Describe how the boxes may be controlled from a dobby or from a jacquard. For what styles of cloth is the latter arrangement necessary or advisable?

15. Describe a revolving box-motion which will permit of any box being brought to the level of the race board at will. Account for its limited use notwithstanding its apparent advantages.

16. Describe an arrangement applied to circular box-looms for putting the cylinder and take-up motion out of action in the event of the weft breaking or running out.

17. Describe a card saving motion, as applied to a dobby and circular box-loom, suitable for weaving large checks, also state what arrangements you would make in the loom to cram the weft at intervals, say, three times as fine as the ground cloth.

18. Describe the card saving arrangements applied to (*a*) the circular box and (*b*) to an eccentric box motion.

19. Describe a checking motion which would give six colours in the weft, one pick of each if necessary. How many shuttles would you use?

20. Name the special features of a loom as regards the method of controlling the picking, checking, and take-up motions which you would select for cloth requiring irregular wefting and in which one pick of a colour only is required in some parts of the checking.

21. Which checking motion do you consider most suitable for the production of (1st) checked shirtings, (2nd) handkerchiefs, (3rd) dobby figured dress goods? Briefly state the reasons for your preference.

22. What principle of checking motion would you recommend to work in conjunction with a jacquard machine (1st) if required to insert extra weft spots at intervals; (2nd) if required for a pick-and-pick three-shuttle tapestry? Give the reasons for your choice, and fully describe the action of one of the two motions you name.

23. State setting of following parts of a check loom in relation to position of crank:—Shedding, picking, weft fork, boxes.

XXXII.—DOBBY SHEDDING.

1. Discuss the merits of the following shedding motions:—Jamieson, Woodcroft, and oscillating tappets, and single and double acting dobbies, under the following heads:—Strain on the yarn in shedding, capacity for weaving light and heavy cloths, figuring capacity or facilities of weave, and general results in the working of the loom.

2. Briefly define the following makes of dobby machines:—Positive, negative, single lift, double lift, centre shed, split shed, open shed, closed shed, and cross border.

3. Explain the essential differences between a single and a double acting dobby. Sketch the arrangement of hooks and needles in each type.

4. (*a*) Describe the principle of any double-lift non-positive dobby, and state any particular merit which you think it possesses. (*b*) The same for any positive dobby either single or double lift.

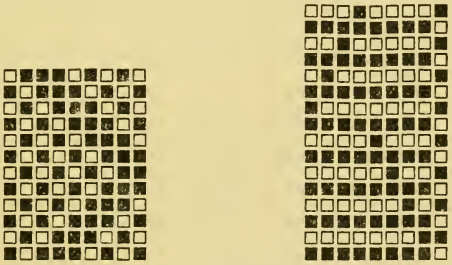
5. Explain the principle of any centre shed dobby. State the class of work for which it is best adapted and the position of the warp threads when the weft is beaten up. What are the effects on the appearance of the cloth, and the wear and tear of the warp threads?

6. Illustrate and describe the construction of an open-shed negative dobby, and give particular attention to the open-shed principle.

7. State the advantages of the Knowles open-shed dobby, and the class of work for which it is best adapted. Draw and describe the essential parts of the machine.

8. Draw and describe two different double-lift dobbies, each of which is arranged to give a straight lift to the healds by cord connections from the jacks to each end of the shafts. State any advantage one of the dobbies may possess over the other, and say if you consider it best to lift the healds from both ends and why.

9. Describe the Keighley dobby. Point out the parts most likely to suffer from wear, and those from breakage. Do you consider the machine suitable for weaving either or both of the accompanying peg plans?



10. How would you time the shedding of a dobby machine, first, for a lightly-wefted plain cloth; and second, for a heavily-picked cloth?

11. Describe an automatic cross border dobby, paying particular attention to the motion for effecting the change of pattern. State the cloths for which it is suitable.

12. Describe a dobby which you consider most suitable for the general run of lenos. Mention any style of leno for which the dobby you describe would either be unsuitable or would require an additional appliance. In the latter case describe the appliance you would use.

13. Describe a vertical hook dobby for weaving dhootie bordered cloth up to 40 jacks. Explain how you would build the harness and otherwise control the figuring yarn.

14. For what classes of cloth is it desirable to control shedding, picking, shuttle-boxes, and take-up from a common source? Describe an arrangement of this kind.

15. What is meant by a "right-hand" and a "left-hand" dobby? How does the arrangement of the hooks and needles in each, together with the driving of the loom and cylinder, affect the method to be followed in pegging the lags? Illustrate your answer by drawing the lags for a 12-end twill to weave in a 16-shaft machine.

XXXIII.—JACQUARD SHEDDING.

1. Define the terms "needle," "hook," "griffe," and "cylinder" as applied to the jacquard machine. Also define "single lift," "double lift single cylinder," and "double lift double cylinder" machines, describing the classes of work each is specially suitable for.

2. Draw sections showing needles, hooks, griffes, and cylinders in the three types of machines named in the above question.

3. Explain the difference between the following counts of jacquards, and describe the arrangement of hooks and needles in each:—100, 200, 300, 400, 500, 600, 900. Draw one row of hooks and needles in a 600's machine, showing half of the hooks lifted and half left down. Also show the cords from these hooks as tied up in a cumber-board 4 holes in a row, numbering them all in their consecutive order.

4. Draw a cross section of a 400 single-lift jacquard, showing variation of space between each of the eight hooks to allow for the difference in leverage exercised by the position of the needle on each hook. Breadth of bottom board over all 7 ins., from centre of first to centre of last hook $6\frac{3}{8}$ ins.; distance of bottom needle from bottom board $6\frac{5}{8}$ ins.; length of hook $10\frac{5}{8}$ ins.; needles pressed back by card 7/16 ins.; $\frac{1}{4}$ in. to be allowed for knife between each hook.

5. Describe the arrangements for supporting, actuating, and adjusting the cylinder of a jacquard. State the correct timing and setting of the cylinder to the needles and the griffe. Where should the griffe be when the cylinder is pressing in most, and what is the effect of too much or too little pressure upon the cylinder?

6. State the causes and effects of hooks "missing" and of "stitching." Suppose the fault to arise from incorrect setting or timing of the cylinder, how would you proceed to correct it?

7. Describe an arrangement for actuating a jacquard cylinder from the griffe, and one which actuates it independently of the griffe. State the merits of either system, also of hexagonal cylinders.

8. Draw and describe an arrangement for working a jacquard cylinder to give two or more picks to a card, and name one or two distinct structures of cloth for which such an arrangement is used.

9. Describe various methods of lifting jacquard griffes, both single and double lift, and also when two or more jacquards are placed on one loom. What arrangements are provided for the conveyance of the cards to and from the cylinder; how may damage to the cards by the cylinder be caused or avoided? Give the proper timing of the griffes with relation to the shedding.

10. Draw a positive tappet to control the lifting of a jacquard which has to change a card or shed only once every six picks. The particulars of change for one pick to be ⅓rd of a pick open dwell, 5/24ths for closing, 3/24ths for bottom dwell or for hooks to clear, 8/24ths for opening the shed. Use your own dimensions.

11. Construct a tappet pattern for a jacquard lift, 4 picks to a card. The griffe to remain up during the insertion of 4 picks, and to change between 4th and 5th pick. Dimensions:—3 inches from centre of tappet to lowest point of contact with 2-inch friction bowl; 3-inch lift. Allow—

1/3	of a	pick	for the dwell	Draw ¼ size.
2/9	,,	,,	closing the shed	
1/9	,,	,,	hooks changing	
1/3	,,	,,	for lifting griffe	

12. Assuming that a jacquard has only to change a card or shed every fifth pick, draw a positive tappet which shall control the machine, the particulars of change for the one pick to be ⅕ pick open dwell, 5/24 to close the shed, 3/24 for bottom dwell or for hooks to clear, 8/24 to open the shed. Give your own dimensions.

13. In the weaving of some compound fabrics the jacquard griffe remains lifted for several picks, during which time the cumber-boards or healds operate. Explain the structure of any kind of cloth woven in this manner, and make a rough sketch illustrating the shape of cam necessary to keep the "shed" open three picks and to change between the third and fourth picks. Show where the cam would be placed on the loom in order to control the lift.

14. Describe a double-lift single-cylinder jacquard illustrating the arrangement of hooks and needles. Explain how the machine is actuated from the loom, and the timing and setting of the driving cranks or eccentrics in relation to the loom cranks.

15. Explain the construction and action of the double-lift double-cylinder jacquard. Compare its merits with the single-cylinder double-lift machine, and say for what class of work either may have an advantage over the other.

16. Describe any motion which may be applied to a double-lift jacquard to prevent "miss picks" or "miss sheds." Also an arrangement for turning cards back when finding the pick.

17. What is an "open shed" jacquard? Sketch the essential parts of the machine, and describe its construction and action. What limitations prevent its more general adoption, and under what circumstances and for what particular build of cloth would you recommend its use?

18. Describe the special features of the following jacquards:—(*a*) The twin machine for weaving double plain cloth; (*b*) the leno jacquard; (*c*) a jacquard for terry towelling; (*d*) the split shed jacquard; (*e*) the Brussels carpet jacquard; (*f*) a fine index jacquard, *i.e.*, a machine having the hooks and needles finer in pitch than the ordinary English jacquard.

19. Explain the method of operating griffes and cylinders in a Crossley or other cross border jacquard. Sketch the arrangement of needles, hooks, griffes, and cylinders, and assess the value of the machine for the particular purpose.

20. Describe the process of building a jacquard harness, including the setting and adjustment of parts, and the means adopted for securing levelness of the mails. What constitutes a good dressing, and how is it applied? Explain what is meant by the "London" and the "Norwich" tie of harness.

21. What is meant by "warped," "single thread," and "knotted" harness? What is the advantage of, or when is each kind used? Give (*a*) height of cumber-board in the loom; (*b*) height of machine foot from mails for 45-in., 60-in., and 90-in. reed space looms, and also the conditions which determine these heights. Why are jacquards placed with the cylinders at the front, back, or side of the loom?

22. Draw plans showing the connection of harness cords to the hooks and their distribution in the cumber-board for the following ties:—(*a*) Lay over; (*b*) point or Vandyke; (*c*) bordered for a table cover and also for a bed quilt.

23. Sketch the styles of ornament suitable for each of the ties mentioned in question 22.

24. Arrange tie-up for a 400's jacquard, 60 ends per inch, 25 inches of yarn in the reed, as follows:—

8	hooks	selvages
100	,,	border Vandyke
80	,,	,, single
220	,,	centre lift over or repeat
408		

25. Draw a harness mounting, 4 ins. to the foot, for a 400's jacquard, 20-in. centre 200 hooks, and 4 ins. border 200 hooks. Only the first and last rows of hooks and cords in each section need be shown.

26. A design consists of borders and three repeats of a centre pattern. Describe the method of tying-up by the Norwich and also the London tie. It will be sufficient to sketch the attachments of the first and last hooks of each part of the design.

27. Sketch the tie-up for a bordered shawl in a 384 jacquard, having 192 wires for border, and 192 for centre and edges; allow 4 ins. for each edge and 12 ins. for each border. Cumber-board 80 ins. wide and 80 ends per inch.

28. A bordered fabric is made as follows (400 jacquard, 80 threads per inch) :—2 ins. ground, 3 ins. border, 50 ins. ground, 3 ins. border, 2 ins. ground. The ground weave repeats on 2 ins. and the border on 3 ins. Set out the harness tie to produce it, and explain an arrangement in the jacquard for weaving the cross border without changing the cards.

29. Describe and give a few sketches showing how the figuring capacity of a jacquard may be increased by the arrangement of the harness tie.

30. Describe the various methods of supporting jacquards above looms. Show which is the most convenient way for the cards to fall, and how this affects the nature of the harness tie. What are the factors which determine the weight of lingoes to be used, and what results would follow if they were too light or too heavy for the work? Select a particular case, and give weight of lingoes you would use.

31. Describe the function and construction of the different forms of cumber-boards in common use. Explain the part which cumber-boards may be made to take in the formation of compound fabrics, the advantages which are thereby gained, and the limitations which their use imposes upon the structure or ornament of the fabric. Illustrate your answer by reference to any typical fabric.

32. What do you understand by a "Bannister" or "double-scale" harness? What advantages are derived from its use? State any fabrics which may be advantageously woven on this system.

33. For what class of goods is a "split" or "double-scale" harness used? Mark out a small design on about 24 hooks to weave with an 8-end satin ground. Give card-cutting instructions, and explain how the ground weave would be produced.

34. Sketch and describe the pressure harness showing one shaft in each possible position and warp threads drawn through the harness. Explain how the shafts are lifted into the positions shown.

35. State the advantage of using pressure harness instead of full harness. Which will produce the most perfect pattern, and why? Illustrate by small designs what are the merits of the pressure harness compared with the Bannister harness.

36. Describe a jacquard which is intended to perform the same work as a pressure harness. State the relative advantages of the two plans.

37. Describe the jacquard mounting arrangement which you consider gives the greatest power of control over the warp in a compound fabric, and explain any attachment which may economise cards or increase the effect of the design.

38. Describe any arrangement of jacquard shedding which greatly increases the number of ends to the repeat of the design in proportion to the number of hooks. Name any fabrics for which the arrangement can be used, and explain how it may affect the method of designing.

39. Describe any jacquard machine or arrangement of jacquard harness and healds, which is calculated to simplify the designing of the fabric produced.

40. What would be the difference in arrangement of the healds and jacquard harness for—

(*a*) Broad stripes of plain calico and figured effects?

(*b*) Alhambra quilts?

(*c*) Tapestry with binding warp?

41. For what purposes are the following compound harness mountings used :—

1. Harness and pressure healds?
2. Harness and ordinary heald shafts, either in front or behind harness?
3. In which rows of harness cords may be lifted by special shafts and the latter controlled by tappets or a dobby, the harness also being workable independently of the shafts?

42. Find the capacity of a jacquard when the harness contains 4,608 cords, set 36 inches in the cumber-board and gives a pattern 3 inches wide.

43. Ascertain the number of harness cords tied to each neck band in a 600-machine weaving a striped cloth arranged—

4	inches	with	80	ends	per inch
1	,,	,,	120	,,	,,
2	,,	,,	80	,,	,,
1	,,	,,	120	,,	,,

32 inches wide in the reed.

44. How many cords must be tied to each hook in a border mounting tied up as follows :—192 hooks border, 192 hooks centre and edges; 60 ends per inch, 80 inches wide; 4 inches each edge, 12 inches each border, and 48 inches centre? Also the number of

cords to a hook for the following stripe pattern 32 inches wide, 84 ends per inch?

A	B	A	C
96 ends	96	96	192

45. Explain the principle of casting-out in jacquard harnesses, or adapting them to suit different reeds or designs than those for which they were originally built. Give the order of casting-out, card-cutter's instructions, and any other necessary particulars for the following examples:—

	Jacquard.	Harness.	Required Cloth or Design.
(*a*)	304 hooks	80 sett	60 reed (*i.e.*, 60 ends per inch)
(*b*)	304 ,,	80 ,,	70 end design
(*c*)	192 ,,	60 ,,	160 ,, ,,
(*d*)	384 ,,	80 ,,	288 ,, ,, also 336 ends
(*e*)	304 ,,	120 ,,	60 reed, 304 end design
(*f*)	408 ,,	90 ,,	72 ,, 110 ,,
(*g*)	384 ,,	tied for 3 in patt.	96 ,, 72 ,,
(*h*)	384 ,,	9 repeats in 36 ins.	84 ,, 168 ,,
(*i*)	384 ,,	96 sett, 36 ins.	80 ,, 32 ins. wide

46. Give the cast-out to weave a crammed stripe cloth in a reed with 30 dents per inch, using a 304-jacquard tied-up for 80 ends per inch. Stripe as follows:—

16 ends 1 per dent
6 ,, 3 ,,
38 ,, 1 ,,
6 ,, 3 ,,

47. If you had a warp containing 120 threads per inch, weaving with a 600-jacquard, and you wish to make a cloth in a reed 32 dents per inch, with 2 threads and 4 threads in alternate dents, using the same harness mounting, how many hooks would be cast-out? Would it be possible to arrange 4 extra warp spots of 24 threads each to the repeat, and, if so, how many hooks would still be cast out?

48. If a lay-over jacquard harness, 384 hooks to a repeat, was weaving a design 4 inches square, state in detail what arrangements you would make in order to produce the design in approximately the same size with 80 threads per inch in reed; also what would you do if required to make the design 6 inches square in a reed with 64 threads per inch?

49. If a 600-jacquard had been weaving cloth in a reed with 40 dents per inch 2 in a dent, and you wished to weave cloth containing cord and satin lines on a ground of plain cloth, how many dents of satin, 4 in a dent, would you be able to arrange if you used the same reed and introduced 6 cords of 2/16's, one end per dent, every $1\frac{1}{2}$ ins.? Also how many dents of satin would you be able to arrange to each $1\frac{1}{2}$-in. repeat if you retained 6 cords per pattern and reduced the reed to 36 dents per inch?

50. If you had used 396 hooks of a jacquard with a straight over-tie, built to suit a reed with 36 dents per inch, 2 ends per dent, and you wished to arrange a satin stripe of 44 ends, 4 in a dent, every half repeat, what reed would it be necessary to use?

51. Supposing a 384-jacquard harness was built to suit a reed 32 dents per inch, two ends in a dent, and you wished to produce a zephyr design with warper's pattern as given below, what counts of reed would you employ?

WARPER'S PATTERN.

44 slate, 2 in a dent
1 white cord, 2/16's in 1 dent
4 white, 2 in a dent
1 white cord, 2/16's in 1 dent
8 slate, 2 in a dent
1 white cord, 2/16's in 1 dent
4 white, 2 in a dent
1 white cord, 2/16's in 1 dent

64 threads

52. Suggest any special features which may be introduced into designs whereby a jacquard harness built for a certain reed could be used for a finer reed (1) by introducing special weaves into the cloth, and (2) by adding stripes to be operated by healds. Explain fully what alterations are usually made when cloth is required in a coarser reed.

53. Describe the piano card-cutting machine. Explain the difference between the cards used on 100's, 200's, 400's, and 600's jacquards, and how the cutting machine is adjusted to these different sizes. Sketch a 400's card showing the position of the lace and peg holes.

54. Describe the operation of jacquard card-lacing, and show how the manner in which it is performed may either help or hinder the weaving. How are the cards supported in the loom and conveyed to the cylinder, and how may hindrance to the weaving arise at these points?

55. Describe the various methods of lacing cards by machinery; compare their relative values as to convenience, durability, and cost, with each other, and with hand-lacing. How would you lace cards for a double-lift, double-cylinder jacquard?

56. Explain the principle of the card-repeating machines in general use, and fully describe one of them.

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